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Hyla microeximia sp. n., Hylidae, Amphibia, from Jalisco, Mexico

By T. Paul Maslin

During the course of a collecting expedition in various parts of western and south-central Mexico during the summer of 1956 a species of *Hyla* was collected which appears to be new.

Hyla microeximia sp. n.

Holotype. U. S. National Museum, No. 139246, an adult male collected 3 mi. N. W. of Jocotepec in the Lake Chapala area, Jalisco, Mexico, June 20, 1956.

Paratypes. University of Colorado Museum Nos. 8369-8378, 8380-8383 males, and 8384-8407 females; all from the same location.

Diagnosis. A *Hyla* of the *eximia* group, of diminutive size, largest male 26.0 mm. snout to vent, largest female 24.6 mm.; choanae small, no larger than a vomerine boss; vomerine teeth in two distinct patches of three to five teeth each, lying close together between choanae, or a little posterior to a line joining posterior edges of choanae; tympanum indistinct, texture and color like adjacent skin, lower edges only slightly raised; digital pads distinct, largest pad on third finger 4/5 as large as tympanic membrane.

Color predominantly green; brown lateral stripe arching dorsally just anterior to inguen to join dorsolateral stripe which extends to point medial of eye; posterior surface of thigh not reticulated, evenly and lightly dusted with minute melanic spots.

Description of type. Adult male, 22.3 mm. snout to vent; width of head at level of jaw articulation 7.4 mm., length of head from posterior face of jaw articulation to tip of snout 7.4 mm. Snout roundly pointed, extending .9 mm. beyond lip. See table for other measurements. Canthal folds distinct, nearly angulate, slightly concave medially, anteriorly extrapolated intersecting at snout forming a 25° angle. Tympanum indistinct, ventral and anterior rim scarcely raised, membrane not differentiated from adjacent skin, longitudinal diameter equal to distance from eye, slightly less than ½ diameter of eye. Longitudinal diameter of eye equal to distance from naris. Ratio of eye-to-naris/naris-to-snout, 5.3; distance between nares equal to distance of naris to eye. Upper eyelid poorly developed, minutely rugose like rest of head; width of eyelid slightly less than distance between eyelids.

Entire arm except fingers and palm coarsely granulated, but not so distinctly as belly and chest. Nuptial pad unpigmented, involving first finger only. Webbing completely absent between third and fourth fingers, trace of webbing between first and second and second and third. No double subarticular pads on fingers. Terminal digital pads distinct, pad of third digit the largest and about 4/5 as wide as tympanic membrane, roundly truncated.

Center of heel articulation of forwardly-adpressed leg reaching level of center of eye. Heels overlap 1 mm. with legs flexed and thighs at right angles to body. Plantar tubercles weakly developed, outer tubercle especially so. Webbing between basal thirds of toes, extending to be-

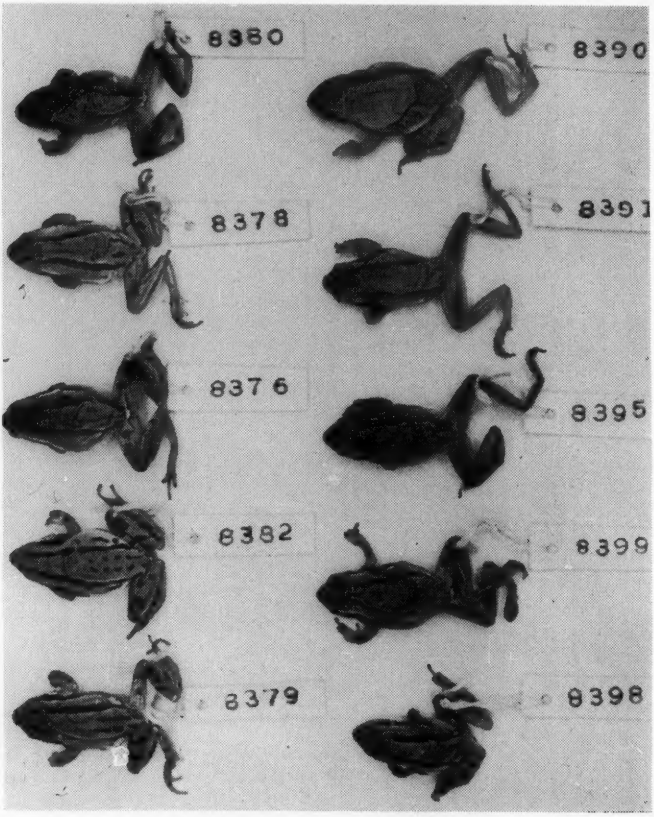

Fig. 1. *Hyla microeximia* sp. n.

Variation in color pattern. Left five specimens, males; right five, females; lower left specimen is the holotype.

tween metatarsal-first phalangial articulations of toes I, II, and III and to between first and second phalangial articulations of toes III, IV, and V; webbing often less but never more. No double subarticular pads; tarsal fold present. Heel and ventrolateral face of tarsum weakly pustulate.

Entire ventral surface of chest, abdomen, thigh and upper foreleg coarsely granulated. Throat, from transverse pectoral fold to mandible, also granulate but less distinctly so, granules more pustule-like and widely separated.

Vomerine teeth in two compact patches; about four teeth in each patch. Vomerine bosses in contact with each other medially; slightly ovate in outline; a little wider than long but not twice as wide; larger than choanæ; separated from choanæ by distance equal to their greatest breadth; lying on a line joining posterior margins of choanae. Tongue about 1/3 free posteriorly, slightly notched, not papillate.

Color predominantly green above, pale cream below. (Gray and cream in alcohol). A brown band with undulant edges from snout over naris to eye and posteriorly from eye diagonally over shoulder, increasing in breadth to sides of body where lower edge fades off into ventral rugosities. Upper edge sharply delineated and darker, arching dorsally just anterior to inguen and joining dorsolateral stripes. Lateral stripe bordered above by narrow penumbra of silvery white. Upper lid with brown stripe narrowing posteriorly and terminating just short of angle of mouth. Between labial stripe and lateral stripe a silvery white stripe about half diameter of lateral brown stripe behind eye, passing from snout to shoulder. Two longitudinal brown stripes from between eyes to inguen, over ilium, with undulant uneven edges and faint penumbra of silver to light bronze on lateral and medial edges. Traces of spots between lateral and dorsolateral stripes posteriorly. Paravertebral rows of spots without penumbra extending from near cloaca to between shoulders where they converge and terminate. Flexed legs crossed by two uneven transverse brown bars. Dorsal surface of legs and arms silvery green. Wrist crossed by brown bar; antebrachial region brown, pustules in brown areas white tipped. Posterior face of thigh, lateral face of shank and medial face of foot with a brown stripe fading ventrally. Posterior face of thigh evenly pigmented with minute specks of melanin. Pustules on median face of tarsus white-tipped as are plantar tubercles. Belly pale cream, gular sac only slightly pigmented. Posterodorsal brown stripes of thigh joining each other above cloaca and here bordered above by a conspicuous silvery area. Eyes black, heavily speckled with silver.

Habits and Habitat. The type and paratypes listed and described above represent all the individuals present in a single breeding congregation. The congregation was found about 8:30 A.M. on an open slope close to several masses of basalt outcroppings overgrown with small trees and surrounded by corn fields. The grass, weeds, and rocks in the area were still wet from a light rain the previous evening. The congregation itself was found on a few isolated and eroded basaltic boulders some twenty feet from a large tree-covered outcropping. These boulders were surrounded by a large-leafed nettle-like weed standing some 2½ feet high. No running or standing water was within thirty yards of the area. The nearest water consisted of a trickle in the borrow ditch beside the main highway No. 15 to Guadalajara. The individuals were found nestled

Table 1. Measurements of *Hyla microeximia*

Univ. of Colo. Mus. No. & Sex	Snout to vent	Snout to eye	Head length to angle of jaw	Head width at jaw angles	Diameter of tympanum	Diameter of eye	Eye to naris	Heel overlap	Arm	Leg	Tibia	Foot & Tarsus	Foot
8372 ♂	23.3	3.6	7.4	7.4	.8	2.1	1.8	1.4	12.5	35.4	12.0	16.6	10.5
8374 ♂	22.2	3.2	6.8	6.7	1.0	1.9	2.0	2.4	11.2	32.7	10.0	15.4	8.7
8375 ♂	24.9	4.6	7.4	7.7	1.0	2.0	1.9	1.5	12.6	34.6	11.3	17.3	10.5
8376 ♂	23.5	3.3	7.4	7.0	.7	2.1	2.1	2.6	11.7	33.6	10.8	16.2	9.5
8378 ♂	23.2	3.5	7.3	7.2	1.0	1.8	1.8	1.4	12.8	33.3	11.2	16.3	10.0
8379* ♂	22.3	3.4	7.4	7.4	.9	1.9	1.9	1.0	12.4	31.7	10.3	15.9	9.8
8380 ♂	23.4	3.3	7.2	7.4	.7	1.8	1.9	2.7	12.4	33.2	10.7	15.2	9.7
8381 ♂	26.0	3.7	8.1	8.3	1.0	2.0	2.0	1.4	12.5	37.4	12.0	17.3	10.3
8382 ♂	23.9	3.5	7.3	7.1	.9	2.0	1.9	1.8	12.2	35.4	11.1	15.7	10.0
8383 ♂	26.0	3.7	8.3	8.2	1.0	2.0	1.9	1.1	12.4	37.4	12.0	17.5	10.8
8384 ♀	22.5	3.1	7.0	6.8	.7	1.8	1.7	2.0	11.4	32.3	9.7	14.5	9.2
8386 ♀	21.8	3.1	6.8	6.7	.8	1.7	1.7	1.6	11.4	31.4	10.3	14.4	8.5
8387 ♀	25.4	3.4	8.0	8.2	1.0	2.0	1.7	1.7	12.6	35.3	11.5	16.9	10.3
8388 ♀	22.2	3.2	6.9	6.2	.7	1.7	1.5	2.0	11.2	31.3	9.9	14.3	7.9
8390 ♀	25.6	3.4	8.0	8.0	1.0	2.0	1.8	1.4	12.2	36.3	11.9	15.8	10.2
8391 ♀	23.3	3.2	6.4	6.6	.6	1.8	1.8	2.0	11.9	32.8	10.4	15.3	8.4
8393 ♀	23.2	3.3	7.4	7.4	.8	1.9	1.8	.9	12.3	33.6	10.4	15.2	9.4
8395 ♀	23.3	3.4	7.4	7.3	.9	1.8	1.8	1.8	12.8	34.0	10.7	15.3	9.1
8398 ♀	21.4	3.2	6.9	6.7	.9	1.7	1.6	1.4	10.7	32.5	10.4	14.0	8.5
8399 ♀	22.4	3.3	7.3	7.2	.9	1.7	1.7	1.7	11.4	31.4	9.9	14.0	8.7

*Type

into the eroded cups of the rocks or on the leaves of the surrounding weeds one to 2½ feet above the ground. None was found on the grass or on the ground itself. The whole congregation covered an area of some thirty square feet. This habitat is in striking contrast to the breeding aggregations of *H. eximia*. In this latter species the males sing while sitting at the bases of clumps of grass in very shallow water or on water-drenched land within a few feet of the water. Females occur interspersed among the males in the same general area.

H. microeximia also has a song recognizably different from *H. eximia*. It was this song, sporadically voiced during the daylight hours while I collected in the vicinity, that finally led me to the breeding congregation.

The voice is not at all piercing and is scarcely audible at more than thirty yards. It consists in the usual single short hylid bleat given at intervals of four to five seconds, but the upwardly inflected bleat is hoarse and broken into separate clicks with little resonance and few overtones. It is not musical nor is it a continuous sharply inflected bleat like that of *H. eximia.* A single choral sequence would last about five minutes and then cease only to be resumed again some fifteen or twenty minutes later.

The specimens were collected and placed in a wet cloth bag. Some three hours later, back at Jocotepec, three pairs were found in amplexus. Later examination of the preserved specimens showed that all but the smallest females had at least some fully developed pigmented eggs in the ovaries. The testes of all but the smallest males are enlarged and mature.

Remarks. Taylor (1938 Bull. Univ. Kansas 39:421-445), in his discussion of *Hyla eximia,* remarks on the tendency of this species to break up into poorly defined races. One of these, variety B, undoubtedly is based in part on specimens of *H. microeximia,* especially that subdivision of variety B which occurs in Jalisco and Nayarit and in which spots tend to occur between the dorsolateral lines. *H. microeximia* is strikingly similar to *eximia* in color pattern and proportion of parts. Only through the luck of collecting a pure breeding congregation of the former was it possible to appreciate the significant differences which do exist. *H. microeximia* seems to be the most closely related to *eximia* from which it differs principally in size. The muzzle is a little sharper, the gular region more rugose as are the arms. The tympanum is a trifle smaller, farther from the eye, less obliquely canted and very seldom shows any differential lightening around its circumference. The lower edge of the tympanic ring is only very slightly raised whereas in *eximia* a distinct raised ridge around the tympanum is present. This is possibly the best character other than size and song in differentiating the forms. The vomerine teeth of *eximia* are usually arranged in a crescent on a diagonally oriented boss nearly twice as wide as long. The vomerine teeth of *microeximia* are more crowded and the boss on which they occur is shorter and less diagonally disposed. In this respect they approach the condition found in *H. cardenasi* and *H. lafrentzi.*

The only other species with which *H. microeximia* might be confused is *H. gracilipes* Cope. Taylor (*op. cit.*) has reviewed the nomenclatorial history of *gracilipes* and concurs with Günther (1901, Biologia Centrali-Americana), placing it in the synonymy of *H. eximia.* He could find only differences so slight as to be regarded as negligible when compared to specimens of *eximia* from the type locality. The chief differentiating characters as described by Cope (1865, Proc. Acad. Nat. Sci. Phila., 17: 185-198) are the remarkably elongate feet, and the nature and disposition of the vomerine teeth. It is interesting, furthermore, that he (*op. cit.:* 195) considered *gracilipes* to be "a species near in technical characters to *ewingii, regilla* and *squirella* but abundantly distinct from all in its sacrum, feet, head, etc." There is no mention of *eximia,* although specimens were available to him including the type. Taylor has re-examined this material and finds that in one specimen of the four upon which Cope based his description the foot is a trifle longer than is normal for *eximia.*

The vomerine teeth of *gracilipes,* as described by Cope, suggest the condition exhibited by *cárdenasi, lafrentzi,* and *microeximia.* Variation in the vomerine teeth arrangement of *eximia,* however, are extensive and in this latter species at least, specimens are often found which resemble *cárdenasi* and *microeximia.* Taylor has drawn attention to the small size of *gracilipes.* Kellogg (1932, Bull. U. S. Nat. Mus., 160:168) measured these specimens and found them to range from 28.6 to 35.3 mm. After comparing these with the only specimens whose measurements Cope published he designated the largest, USNM No. 15321, as the lectotype. Cope's measurement of this specimen is 15 lines (31.75 mm.). Taylor also measured the same specimens and found them to vary from 28 to 33 mm. The small size suggested that they might be juveniles, but upon examination he found that two of the specimens had ovaries filled with ripe eggs.

The available specimens of *H. microeximia* differ from *gracilipes* in a number of other characters, some obviously of little significance. The foot is not exceptionally long, and in this character the species resembles *eximia* and *gracilipes* as pointed out by Taylor (*loc. cit.*). The vomerine teeth and the position of the vomerine boss resemble those of *gracilipes,* but the posterolateral "convexity" I cannot recognize. The color pattern of *gracilipes* is more like that of typical *eximia* than *microeximia.* The lateral brown stripe commences anterior to the naris and extends all the way down the flanks and arches up to join the dorsolateral stripes in *microeximia.* In *gracilipes* and *eximia* this stripe fades away on the flanks. The dorsolateral stripes of *microeximia* extend anteriorly past the sacrum and onto the head, and finally the hind limbs are cross-barred in *microeximia.* The greatest difference lies in the still smaller size of *microeximia* (see table), the largest specimens measuring only 26 mm. from snout to vent. If more material from the area of Mirador, Veracruz, is discovered which would necessitate the revival of Cope's *gracilipes* it may transpire that *microeximia* will prove to be a diminutive subspecies of this form.

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DEPT. OF BIOL., UNIVERSITY OF COLORADO, BOULDER

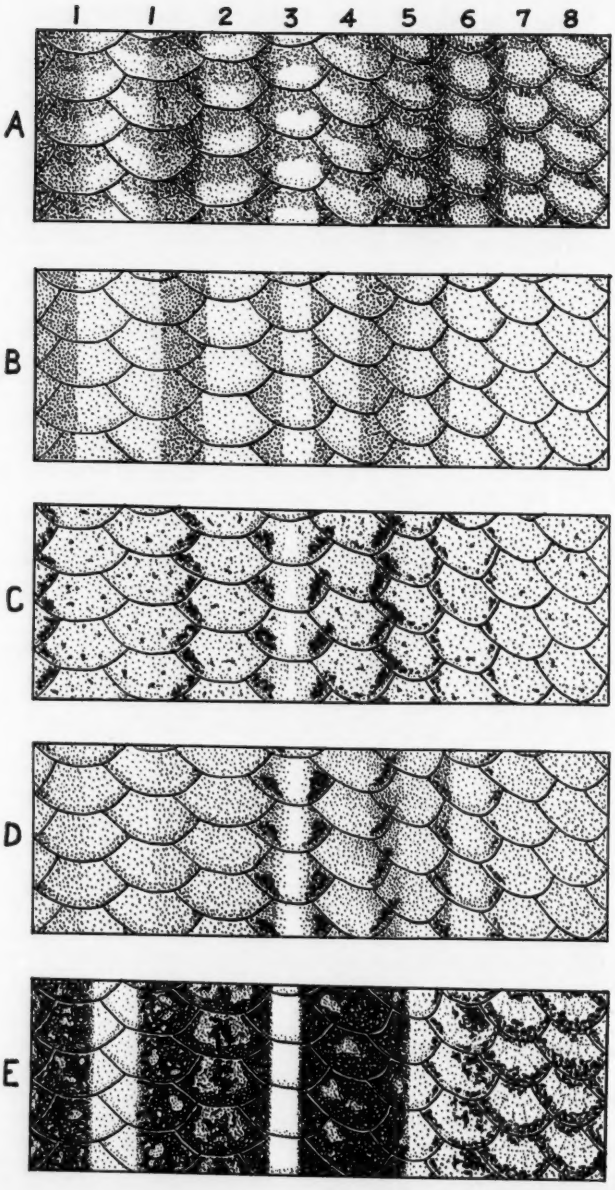
Notes on the Lizard *Eumeces multivirgatus gaigeae* from Colorado and Utah

By T. Paul Maslin

Dr. W. A. Weber and party collected a series of seven skinks ½-mi. SE Pagosa Springs, alt. 8,000′, Archuleta Co., Colorado, 21 June 1951; University of Colorado Museum numbers 6006-12. Two years later Diana and Nell Maslin, Kit Havice and I collected another series of eight skinks (Univ. Colo. Mus. Nos. 6585-92), June 1953, in Devil's Canyon, State Highway 47, 12 mi. S. Monticello, alt. abt. 8,300′, San Juan Co., Utah. Other activities prevented the processing of these specimens for several years. In the meantime Lowe (1955, Herpetologica, 11:233-5) contended that the three species *E. multivirgatus* (Hallowell), *E. gaigeae* Taylor and *E. taylori* Smith are but races of one species, *E. multivirgatus*. I follow him here in assigning all the specimens listed above to the race *E. m. gaigeae*.

Shortly before Lowe's paper appeared Dr. John S. Mecham borrowed the extensive series of *E. multivirgatus* available at the University of Colorado Museum with the intent of studying this same complex (see also Lowe, *op. cit:* 233, footnote). A description of these specimens of *E. gaigeae* from Colorado and Utah, which were not available to Mecham at that time, was withheld pending the appearance of his paper. As his findings are still unpublished at this writing, and interest in this complex is high, I am making known the existence of this additional material and including some pertinent notes and observations.

The fifteen specimens reported on here exhibit all the characters described by Taylor (1935, Univ. of Kans. Sci. Bull., 23:340-341) as being typical of the *multivirgatus* group. Furthermore the five adult Utah specimens perfectly fit his original description of *gaigeae* (1935, Univ. of Kans. Sci. Bull., 22:219-223, fig.), and the seven Archuleta County specimens also fit the detailed description given by him (*op. cit.*, 23: 356) of a specimen in the University of Michigan Museum (No. 70517) from near Frijoles, Culberson Co., Texas. This latter description points out the great similarity between the basic color pattern of adult *multivirgatus* and *gaigeae*. The chief differences lie in the intensity of the patterns and the relative widths of the various stripes (see Fig. 1 B, C, D). A cursory examination of an adult *gaigeae* gives the impression of a two-striped skink, but closer examination shows faint traces of all the primary and secondary stripes typical of *multivirgatus*. It is in the juveniles that the races differ most strikingly. The juvenile pattern of *multivirgatus* (Fig. 1 A) is much darker than that of the adult and with less sharply delineated lines, but essentially it is the same pattern. The juveniles of *gaigeae*, on the other hand, show strikingly brilliant three-lined pattern (Fig. 1 E) with more sharply delineated lines. The pattern is reminiscent of that of the *fasciatus* group rather than the *multivirgatus* pattern; this similarity extends also to the bifurcation of the median line of the head. The ontogenetic change from a bold pattern of this sort to the typical *gaigeae* pattern of the adult is a major difference between these two races. The Utah series makes it necessary to modify some of Lowe's


1 1 2 3 4 5 6 7 8
A
B
C
D
E

statements. Lowe (*op. cit.*: 233) states that in the adult color patterns of the three races which he recognizes "there is a general north-south decrease in intensity of the development of the body stripes in the adult, from the well-striped *multivirgatus* of the north, through the variably-striped *gaigeae* in a somewhat geographically central position, to the non-striped *taylori* found only in the south (Guadalupe Mountains)." The specimens on hand suggest an equally pronounced cline exists from east to west (see Fig. 1 B, C, D). In the next paragraph Lowe (*loc. cit.*) states that these three subspecies "resemble each other more closely as juveniles than as adults." This is certainly not true of the Utah juvenile specimens and the series of juveniles on hand from eastern Colorado. The races differ as much in the juvenile stage as adults do, although both have brilliant blue tails.

The Colorado specimens from Archuleta Co., all females, are intermediate in color pattern between typical *multivirgatus* and *gaigeae* from San Juan Co., Utah. Unfortunately no small specimens are represented in this series, and a possible intermediate juvenile pattern cannot be described. All individuals of the Archuleta Co. series have a bright white stripe on the third scale row which is whiter than the light stripes elsewhere. This seems to be a feature of the *gaigeae* pattern. In *multivirgatus* this stripe, although light, is never white nor is it noticeably lighter than the median stripe.

One morphological character not mentioned or figured by Taylor (*op. cit.*) or by Smith (1946, Handbook Lizards) deserves comment. In the Utah specimens the posterior point of the labial border of the seventh supralabial lies exactly opposite the posterior point of the labial border of the last infralabial. This character is figured by Taylor (23:71) in his depiction of a typical skink. But in his figures of *multivirgatus* (23:345, 353), of *gaigeae* (23:354), and of *humilis*, now a paratype of *taylori* (23:359), this supralabial extends well posterior to the infralabial. In all Utah specimens, except on one side, the posterior labial borders of the last labials lie exactly opposite each other. In the exception the upper labial projects posteriorly by .3 mm. or about 15% of the scale. In the Archuleta Co. series 50% of the right or left sides are exactly opposite each other and in the remaining instances the supralabial projects posteriorly a distance from .2 to .3 mm. Here again these forms demonstrate an intermediate condition between the Utah *gaigeae* and typical *multivirgatus* in which the supralabial normally projects farther than 15% of its labial border posterior to the last infralabial. It should be pointed out that Taylor's (*loc. cit.*) figure of *gaigeae* was made from a specimen collected near the extreme southern reaches of its range.

Fig. 1. Color pattern of the back and right side of forms of *Eumeces multivirgatus*. Numbers across top indicate scale rows from left and right paravertebral rows, the dorso-median line lying between the two numbers one. Lengths measured from snout to posterior edge of preanals. A, *multivirgatus*, juv. ♂, 37 mm., x 13.3, UCM 5701, Weld Co., Colo. B, *multivirgatus*, adult ♀, 70 mm., x 7, UCM 5596, Weld Co., Colo. C, *gaigeae*, adult ♀, 63 mm., x 7.8, UCM 6009, Archuleta Co., Colo. D, *gaigeae*, adult ♀, 65 mm., x 7.7, UCM 6587, San Juan Co., Utah. E, *gaigeae*, juv. ♂, 35 mm., x 14, UCM 6590, San Juan Co., Utah.

A further difference between the two races concerns their habitats. *E. multivirgatus* of eastern Colorado and Nebraska is a prairie lizard, preferring sandy soil or loose sand and avoiding the occasional rocky outcroppings that occur within its range. On the other hand *gaigeae* is essentially a montane form. The Archuleta Co. specimens were found under partially buried, rounded boulders on a steep, open, grassy slope in a forested area above a stream-watered valley. The Utah specimens were also found under rocks in a mesic situation, where yellow pines and scrub oaks formed an open forest. In clearings between trees where loose rocks were present surrounded by grass, either on the banks of the narrow canyon or on its floor, one could expect to find skinks. A small temporary stream runs through this canyon also. These habitats are much like the one in which Taylor (*op. cit.,* 1935) collected the types of *gaigeae* near Taos, New Mexico.

All the adult females collected in Utah were gravid. Three specimens contained four eggs each and the remaining one three. These eggs, still subspherical, though distorted by visceral pressure, were in the ovarian tissue. They were all about the same size, varying from 5.6 mm. to 7.2 mm. in diameter. These specimens were collected on June 7. Of the six fully adult specimens collected on June 21 in Archuleta Co. only four were gravid. The remaining two had undistended oviducts, and normal ovaries containing follicles not more than ½ mm. in diameter. They apparently had not bred that spring. Three of the four gravid females contained five eggs and the fourth had seven. These eggs were in the oviducts and had nearly completely formed shells about them. The eggs all seem to be about the same size but most of them are distorted by visceral pressure. One egg, floating free, as a result of the injection of preservative, measures 11.4 mm. x 6.0 mm. The eggs are leathery, white, and nearly smooth. Apparently oviposition must occur near the end of June at this altitude and latitude.

I wish gratefully to acknowledge the financial assistance rendered me by the University of Colorado Council on Research and Creative Work; and to thank Dr. Weber, Kit Havice and my family for arduously turning over rocks.

UNIVERSITY OF COLORADO MUSEUM, BOULDER

Relationships of the Red-Backed and Zigzag Plethodons in the West*

By GORDON R. THUROW

This is a sister paper to the general character-comparison list given for *Plethodon cinereus* and *dorsalis* (Thurow, 1956), and consists of a more detailed account of the western studies which led to the re-assignment of *angusticlavius* to the species *dorsalis*. This results in a considerable range change for *dorsalis* and affirms Black and Dellinger (1938), contra the usual view that the range does not extend west from southeastern Illinois (Dunn, 1926, Bishop, 1943, Grobman, 1944, and Smith, 1948).

Additional data on variation in the area are also presented. I wish to thank the following persons who made the study material available: H. K. Gloyd, Chicago Academy of Science (CAS); C. H. Pope, R. M. Inger, and H. Marx, Chicago Natural History Museum (CNHM), whose collection includes former University of Rochester specimens (UR); James Böhlke, Academy of Natural Sciences, Philadelphia (ANSP); Esther Bennett, Southern Illinois University Museum (SIUM); H. M. Smith and Mrs. D. M. Smith, University of Illinois Museum of Natural History (UIMNH); and N. Hartweg, C. H. Walker, and W. E. Duellman, University of Michigan Museum of Zoology (UMMZ). My wife, Judith, helped prepare Figure 1.

Missouri and Arkansas Material

Examination of 22 specimens of *angusticlavius* (including 13 paratypes) and 73 specimens of *serratus* (including the type and 32 paratypes) indicates that they are properly assigned to *P. dorsalis* and *P. cinereus*, respectively, according to the criteria given (Thurow, 1956).

The characteristic differences appeared in the number of costal folds; in the number of costal folds between adpressed limbs; and in the secondary sex characters. Most of the *angusticlavius* have 17 costal folds, and nearly all the *serratus* have 18. The number of folds between adpressed limbs is 4½-7 in 18 *angusticlavius*, averaging 5½-6 (one immature had 3½). *P. c. serratus* counts are 7 and 8, averaging about 7½. The premaxillary teeth, snout, and mental gland of *angusticlavius* agree with *dorsalis* and those of *serratus* agree with *cinereus*. As noted, the development of the ventral hedonic glands is less in *P. c. serratus* than in *P. c. cinereus*, but they are still better developed than in *P. d. angusticlavius* and most *P. d. dorsalis*. The general sexual dimorphism appears to be less in both *angusticlavius* and *serratus*, but the change in the hedonic glands of the former is not clearly marked since they are relatively underdeveloped in *P. d. dorsalis* also.

In general the pigment characters of *angusticlavius* agree with *dorsalis* and those of *serratus* with *cinereus*, except for the rostral band, as indicated. Although the band is lacking in *angusticlavius*, the snout pigmentation does not appear identical to that of *cinereus* under the binocular microscope.

The narrow dorsal band of *angusticlavius* (Fig. 1, E) is related to that of *dorsalis* by the subdued development of *dorsalis*-type lobes on its

*Contribution No. 583 from the Zoological Laboratories of Indiana University.

anterior end (at least 6 of the 18 non-ANSP specimens show some suggestion of this, and one juvenile, CNHM 39593, actually has a typical *P. d. dorsalis* pattern). This type of narrow band also occurs as a rare variant in some populations in adjacent parts of the *P. d. dorsalis* range. It occurs with noticeable frequency in large *dorsalis* series from McCormick's Creek State Park, Owen Co., Indiana, and in a series from Crawfordsville, Montgomery Co., Indiana (CNHM 8740). One of 7 from Hardin Co., Illinois, shows this pattern (UIMNH 16454) and one of 8 from Henderson Co., Kentucky (UMMZ 60989). Dunn (1926) records a specimen from Mammoth Cave, Kentucky, and Parker (1939, with addition) probably records some from Obion Co., Tennessee (discussed by Grobman, 1944. Various reasons, including field work at the locality, make me feel that *cinereus* does not occur there, and that Parker refers only to *dorsalis*). The *angusticlavius* band is easily derived from the lobed *dorsalis* band, since the number of lobes on the narrow central band vary widely, usually being reduced from the posterior end (Fig. 1, C).

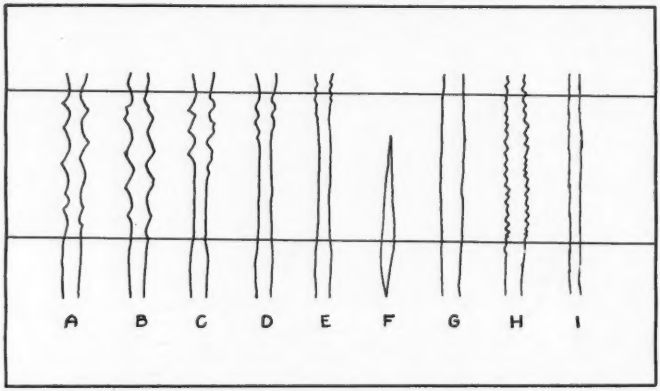


Figure 1. Diagrammatic drawings of *P. dorsalis* and *P. cinereus* dorsal bands (the upper and lower horizontal lines indicate the position of the forelimbs and hindlimbs): A-C, zig-zag, diamond, and semilobed patterns of *P. d. dorsalis* (many combinations exist); D, *P. d. dorsalis/angusticlavius* intergrade; E, *P. d. angusticlavius;* F, aberrant Illinois Grand Canyon *P. d. angusticlavius;* G, *P. c. cinereus;* H, *P. c. serratus;* I, dark or narrow-band phase of *P. c. serratus,* with more indistinct edges and melanophore suffusion than shown.

These *angusticlavius* agree with other *dorsalis* in that the dorsal band (excluding the lobes) becomes wider on the tail, unlike *cinereus,* where the band narrows (Fig. 1). *Serratus*-type bands have been observed in other parts of the *cinereus* range (and the subspecies is not as cleanly separated by this one character as Fig. 1 and the original description might suggest), but never among *P. dorsalis.* Some *serratus* stripes contain the parallel trains of black flecks which are more characteristic of the *cinereus* stripe than the *dorsalis* stripe.

Roughly one fifth of the CNHM *serratus* material is melanistic. Al-

though the degree of melanism varies, the whole aspect of these forms differs, so that they take on the nature of a phase. They are not the ordinary black phase commonly found in *P. cinereus,* however. A narrow fuzzily edged and suffused, but fairly uniform median stripe is left exposed, at least on the tail (Fig. 1, I). Actually the appearance seems to resemble the *angusticlavius* figure and diagnosis of "indistinct edges" given by Grobman (1944, Fig. 6, and p. 302) more closely than does the band pattern of actual *angusticlavius.* The band of this dark *serratus* phase may be difficult to distinguish from the *angusticlavius* band by those unfamiliar with the material, but the other characters allow correct identification.

Although the presence of ventral orange pigment could not be confirmed decisively in these preserved *angusticlavius,* as in the live Illinois material, large unpigmented areas implied this. The *serratus* usually showed remains of guanophore pigment in areas not covered by melanophores.

The total mass of guanophore pigment on the lower flanks, cheek, and gular of *serratus* is noticeably heavier than that of *angusticlavius,* and the mottling of the belly is often a bolder, more contrasting pattern. *P. c. serratus* gives the impression of a rather white, or light, gular with black lip margining (although not as frequently as *P. c. cinereus*), but *angusticlavius* does not. In some *serratus,* however, the lack of melanophores is more conspicuous in the pectoral area than on the gular, a condition usually more typical of *dorsalis* than *cinereus;* and a few *angusticlavius* have a more strongly contrasting pattern of belly mottling than seems typical of *dorsalis.*

Visual comparisons were made of relative growth regressions formed by plotting tail length against the remaining body length (measured to the posterior margin of the hind limbs). Superposition of the translucent graph paper showed general overlap between measurements of 17 western *angusticlavius,* 7 from southwestern Illinois, 33 *P. d. dorsalis* from Indiana, and 32 *dorsalis* from Alabama. Similarly, measurements from 19 *serratus* form a regression that overlaps one from 18 measurement-pairs of *cinereus* from other parts of the range. As expected, the larger *serratus* have longer tails than similar-sized *angusticlavius,* like the parent subspecies.

Measurements support Grobman's comment that *angusticlavius* appears slightly smaller than *cinereus,* but this is true only since *P. dorsalis* is slightly smaller than *P. cinereus.* The largest *angusticlavius* total length measurement from western Illinois was 91 mm. in life and 87 mm. after preservation, and the largest measurement of the more western material is 88 mm. Bishop's largest *P. d. dorsalis* measurement (1943, from Dunn, 1926) is 87, and my largest live measurement is 91 mm.

Grobman's statement that *serratus* seems to be a smaller subspecies is likewise supported. The longest specimen is 92 mm., whereas specimens of 100 mm. occur in collections from several parts of the *P. c. cinereus* range. Lengths as high as 122 mm. (Davis, 1942) have been reported.

The other material examined was from southeastern Missouri. The few comparisons made confirm prior identifications, that this is mostly fairly typical *P. c. cinereus.*

Illinois Material

Fifty-six museum specimens and 22 specimens from two field trips

were compared with each other and with *cinereus* and *dorsalis* from other parts of their ranges. I am convinced that *dorsalis* is represented among the material from Union and Jackson counties. These are very similar to the paratypes of *angusticlavius* from Missouri and Arkansas, and it seems best to regard them all as belonging to the same subspecies.

The same narrow band appears, usually showing faint remnants of lobation at the narrowest anterior end, and becoming widest on the tail, just behind the hind limbs. Measurements of 11 SIUM and UIMNH specimens comparing band and body width at midbody gave a range of 21-40% and a mean of 29.3, which compares well with similar measurements of *angusticlavius* made by Grobman (1944, Table 2). Similar measurements of 7 CNHM intergrades give 30-38% and a 33.9 mean, lobe width not being included.

A north-south internal cline appears in the band pattern of western Illinois *dorsalis*. The trend is from extreme narrowness (almost to obliteration or loss) in the north to an almost typical semi-lobed *dorsalis* type in the south among the specimens regarded as intergrades (Fig. 1, D). If other populations exist along the southern edge of the Illinois highlands, they may continue the cline right into the typical *P. d. dorsalis* band found in Pope and Hardin counties, in southeastern Illinois.

Intergrading populations appear to be represented by specimens south of Illinois Rt. 146 between Jonesboro and Ware, in Union County. They are intermediate in other characters in addition to band shape and width as described above. There is enough melanophore suffusion in most Illinois *angusticlavius* so that the rostral band or spot is absent or very poorly developed, as in *angusticlavius* to the west, but some of these intergrades show more marked spot development.

The band color is not distinctive, but shows regional conformity. Over most of the *dorsalis* range the band is most frequently orange-red, something like 1-A-12* of Maerz and Paul (1930). In Indiana it averages more orange, and varies from pale lemon yellow, Maerz and Paul 9-L-1, through orange 9-L-12 to the orange-reds of page 1, row 12. The live Illinois *angusticlavius* material (with one intergrade) varied from 9-L-3 to 1-K-12, with 12 of the 14 falling between 9-L-7 and 9-L-12.

None of the bands were heavily suffused with melanophores, although such melanism occurs frequently in some other parts of the *dorsalis* range, including southeastern Illinois.

Live *angusticlavius* show a slight reduction in guanophore pigment, and in some of the accompanying gaps in the melanophore bed, when photographs are compared with photographs of live *dorsalis* series from Gatlinburg, Chattanooga, and Reelfoot Lake, Tennessee; Warrior, Alabama; Paoli, Indiana; and Golconda, Pope Co., Illinois. This is not striking enough to be a useful taxonomic character and there is wide individual overlap, but *angusticlavius* averages less, at least in Illinois. The reduction is enough so that the chocolate and silvery mottling frequently seen on the sides of the tail in Indiana, Kentucky, and Tennessee specimens was not noticed. Again, there appears to be a south-to-north internal cline in western Illinois, though less marked. The guanophore pigment in general, and the associated gaps in the ventral and ventrolateral melanophore bed seem to diminish from south to north.

Direct comparisons and numerical and rating data confirm that these specimens are similar to *P. d. dorsalis* in mouth aspect, general proportions, costal grooves, and other pigment characters.

Illinois *angusticlavius* are noted to differ from more western material in that: (1) There is possibly more trace of a rostral spot, which is accounted for by the proximity of intergrades with *P. d. dorsalis*. (2) There is probably a lower frequency of melanism, which appears to be local variation. These are not considered sufficient reasons for subspecific distinction.

The Illinois Grand Canyon Specimens. Two specimens taken from a deep (100 foot) canyon one mile north of the juncture of Cedar Creek and the Big Muddy River are strikingly different from any other *P. dorsalis* I have seen. They completely lack any guanophore pigment, white or iridescent. This changes the whole appearance of the animals, only a mottling of orange and black remaining. The areas of uninterrupted black appear larger, particularly on the belly. The complete lack of guanophores in part of the range of a species of *Plethodon* has been reported before, *e.g.,* the all-black phase of *Plethodon glutinosus* which is common near Charleston, South Carolina (Schmidt, 1924, and others).

The narrowing of the dorsal band seen in *angusticlavius* is even more extreme in these two specimens (Fig. 1, F), and is not approached by any other *dorsalis* examined (melanistic specimens excluded).

These specimens may be (1) merely aberrant individuals; but it is possible that they represent either (2) an aberrant population whose variation accentuates the extreme of an internal cline and simulates a break, or external cline; or (3) another distinctive population occupying a definite geographical area and deserving subspecific recognition. There is no simple geographic north-south partitioning, as typical *angusticlavius* apparently extends north of here to Carbondale, farther in from the edge of the bluffs.

More specimens are needed from the vicinity of Murphysboro and Ava.

Other Considerations

There were still other reasons for re-assigning *angusticlavius* besides the above taxonomic examinations, and which in fact led to the examinations. These are: (1) Studies of the ecology of *dorsalis* and *cinereus* led the author to note that some of the habitat indications given for *cinereus* in western Illinois (Cagle, 1942), actually strongly suggested *dorsalis*. (2) Field trips to southwestern Illinois revealed characteristically narrow-striped populations which were not *cinereus,* although in habitats they were rather similar to *cinereus* because of the season. (3) The Illinois narrow-striped form which had formerly been confused with *cinereus* lives in the Ozark Plateaus physiographic Province, as does the narrow-striped *angusticlavius* of Missouri and Arkansas. (4) The Ozark Plateaus and the Interior Lowland Plateaus provinces are somewhat similar in nature, are continuous with each other, and are co-inhabited by several plethodont species, *e.g., Eurycea longicauda* and *E. lucifuga.* (5) Several of the *angusticlavius* records are associated with caves, and in Indiana *P. dorsalis* is characteristically associated with caves and *P. cinereus* is almost never associated with them. (6) Grobman (1944) described some *angusticlavius* as having a "psuedo-*dorsalis*" pattern.

Ranges

The Illinois range of *P. d. dorsalis* has been indicated by P. W. Smith (1948), whose records from Saline, Pope, Richland, and Vermilion counties indicate that it is generally distributed along the southeastern margin of the state. The records in this paper from Golconda, Pope Co., and about 2 mi. E of Lamb, Hardin Co., may be added to this. No specimens have yet been reported west or south of Pope Co.

Material assigned to *P. d. angusticlavius* was taken from Ware and Anna north through the northwestern part of Union Co. to Carbondale, Jackson Co., east of the Big Muddy River. Samples collected farther south in Union Co. are called intergrades. Cagle's specimens (1942) recorded from near Murphysboro, Jackson Co., were not seen, and may be *P. cinereus*. All the specimens seen were collected in the area of dissected bluffs just east of the Mississippi River. Some form of *P. dorsalis* probably occurs along the bluffs, north to about Ava in Jackson Co., and south into Alexander Co. It is less likely that populations extend east along the southern margin of Illinois to Pope Co., but this is possible. It is also possible that *dorsalis* crossed the Thebes Channel into a tongue of rough but presently badly disturbed upland in Scott Co., Missouri.

The establishment of *P. cinereus* records in southern Illinois becomes a problem. The maps of Dunn (1926) and Bishop (1943) are not helpful, nor are records for "southern Illinois" given by Cope (1889). At least the southernmost dot of the two on Grobman's map (1944) is a *P. d. angusticlavius* record. An unsuccessful search for *cinereus* was made on the trips to southeastern and southwestern Illinois, although it was taken at nearby Evansville, Indiana. It appears that *cinereus* is not presently abundant on the rocky highlands of southern Illinois. Yet Grobman (1944) and others have established that it occurs along the eastern forested margin of the state, and UIMNH 16707-8 show that it does occur in Union Co. I believe that populations once occurred in forests along the northern edge of the southern uplands, penetrating them to some extent, and along the Missouri border, but that deforestation and climatic changes have reduced these.

Most of the specimens seen from west of the Mississippi were examined by Grobman (1944). The known ranges of the three subspecies remain essentially as he designated and mapped them in this area (*op. cit.*, Fig. 7) and examination of ANSP 15575-8 confirms his two probable *angusticlavius* records, but there are additional records.

Grobman examined *P. c. cinereus* material from St. Louis, Jefferson, Butler and "San Francisco" (St. Francois) counties, and has literature records for Madison and St. Francois counties. Mrs. D. M. Smith (in correspondence) stated that there is UIMNH *P. cinereus* material from Jefferson, Iron, Wayne, and Oregon counties, Missouri. The author saw UMMZ specimens from St. Louis Co., Reynolds Co., and Keenar Resort, Keenar, Missouri (probably Butler Co.), although briefly. There are several other records for St. Louis, and especially Jefferson, counties, and Boyer and Heinze (1934) state that *P. cinereus* is perhaps the most abundant salamander in Jefferson Co., although limited to a sandstone belt. It is assumed that most of these Missouri records are *P. c. cinereus*, although a few could possibly be *P. d. angusticlavius*.

Sanders and Smith (1949) report a *P. cinereus* tentatively identified as *P. c. serratus* from Nacogdoches County, Texas.

The Oklahoma records of Dundee (1947) and Bragg (1955) would require re-examination of the specimens. Dundee's Cherokee Co. habitat notes support his *angusticlavius* identification, but the ecological and taxonomic notes of Bragg suggest that both specimens may belong to a *serratus* or *serratus x cinereus* population. Both *P. d. angusticlavius* and *P. cinereus* may occur in the area, and in part of the southern Ozarks. Landform maps show the Arkansas Valley to be less of a *cinereus* barrier by the Oklahoma-Arkansas border, but a search should also be made between Logan Co., Arkansas, and Oregon Co., Missouri—particularly in the more moist relatively undisturbed forests associated with some river bottoms or the north slopes of sandstone-capped hills.

The range of *P. d. angusticlavius* is undoubtedly more extensive than is now known. It should be searched for between its presently known Illinois and Arkansas ranges, particularly in cave and bluff areas along the Missouri side of the Mississippi. Other parts of the Springfield Structural Plain (Fenneman, 1938, fig. 177) should also be searched.

Some points about the ecology of the ranges are worthy of emphasis.

I have collected *P. c. serratus* on Rich Mt. west of Mena, in the mountains east of Mena, Polk Co., and on Mt. Magazine, Logan Co., Arkansas. My field experience and that indicated in the data of other specimens indicates that the normal *cinereus* leaf duff or subforest floor habitat is adhered to, the animals being taken under logs or in leaf duff moistened by rain or slope seepage.

The situation is quite different with Ozark *angusticlavius*. Eleven of the 12 specimens where habitat data were seen (3 of 4 localities) came from caves. The other specimen was a juvenile taken on a road after a rain. These cave records and all other non-Illinois *angusticlavius* records occur within the Springfield Structural Plain (*op. cit.*), which is made up of Mississippi limestone, or the Boston Mountains Plateau (*op. cit.*), which is the same limestone with a partial capping of Pennsylvania sandstone. A large part of the range of *P. d. dorsalis* is underlain by these same limestones, which are excellent cave formers. Most of these western *angusticlavius* localities are near the entrenched White River, with its adjacent moist scarps and some subterranean drainage. All this agrees with field experience in other parts of the *dorsalis* range, that rock outcroppings as well as moisture must be near, and that colonies characteristically occupy caves, when these are present.

There is apparently a geological correlation in the range of Missouri *P. c. cinereus* also. Most of southeastern Missouri is a part of the Salem Platform (*op. cit.*), a bleak, rolling, brush-covered plain with scattered forests, lying on Cambro-Ordovician cherty limestones. The elongate area containing *P. c. cinereus* records has two other features which make it more favorable: the exhumed Precambrian St. Francois Mountains, and sandstone belts. The mountains have more local relief, reducing evaporation and discouraging cultivation, and the sandstone holds more moisture, all favoring heavier forest coverage (the sandstone effect is more marked further south westward, as in the cross timbers of Texas).

SUMMARY

New and old material of western *dorsalis* and *cinereus* are examined and the supporting evidence is presented for the reassignment of the subspecies *angusticlavius* to *P. dorsalis*. The similarities of *angusticlavius* and *cinereus* bands are believed to be the result of parallel evolution. The various band patterns which are figured, plus the leadbacked or unbanded phase of *cinereus* illustrate the tendency towards dorsal pattern reduction and loss which occurs in these two species and in the genus in general. Some geographic variation is described, including two aberrantly pigmented *angusticlavius* from a canyon in southwestern Illinois. Ecological and other supplementary evidence are also brought together.

The ranges of *serratus* and *angusticlavius* are re-examined, as well as that of *P. c. cinereus* in southern Illinois and west of the Mississippi. Some ecological and physiographic factors pertaining to these ranges are described.

WESTERN MATERIAL EXAMINED

Plethodon dorsalis dorsalis: ILLINOIS: *Hardin Co.,* UIMNH (10)*; Pope Co., SIUM (5), personal collection (GRT) (8).

Plethodon d. dorsalis/angusticlavius intergrades: ILLINOIS: *Union Co.,* 6 mi. SW Jonesboro, CNHM (6) and CAS (6); between Jonesboro and Ware, SIUM (6), 2 mi. E Reynoldsville (about 7 mi. SW Jonesboro), GRT (1).

Plethodon dorsalis angusticlavius (fairly typical): ILLINOIS: *Jackson Co.,* Carbondale, CAS (3); Rattlesnake Canyon, by Rattlesnake Ferry (1)**; *Union Co.,* Alto Pass, UIMNH (5); Anna, UMMZ (1); the Pine Hills, SIUM (7)**; the Pine Hills (2 mi. E Aldridge), CAS (2); the Pine Hills (about 3 road mi. N town of Wolf Lake), GRT (11, 10 now CNHM); Wolf Lake, UMMZ (1). MISSOURI: *Christian Co.,* Chadwick, ANSP (2); *Stone Co.,* CNHM (4, once UR, paratypes and topotypes or near topotypes, caves N Reeds Spring). ARKANSAS: *Benton Co.,* Rogers, ANSP (2); *Crawford Co.,* 3 mi. S Locke, CNHM (2, once UR paratypes); *Franklin Co.,* White Rock Mts., CNHM (1); *Independence Co.,* from Crystal Cave, Locust Grove, CNHM (5, once UR paratypes); from Schism Cave, 6 mi. S Batesville, CNHM (2, once UR paratypes); *Washington Co.,* 6 mi. E Springdale, CNHM (4).

Grand Canyon specimens.

Plethodon dorsalis angusticlavius (aberrant): ILLINOIS: *Jackson Co.,* the Grand Canyon, W of Etherton and SW of Murphysboro, GRT (2)

Plethodon cinereus cinereus: ILLINOIS: *Union Co.,* Alto Pass, UIMNH (2). MISSOURI: *Butler Co.,* (probably), Keenar Resort, UMMZ (2)*"; *Iron Co.,* UIMNH (3)**"; *Jefferson Co.,* UIMNH (1)**"; Sand Ridge near Goldman, CNHM (2); *Oregon Co.,* UIMNH (1)**"; *Reynolds Co.,* UMMZ (2)*"; *St. Louis Co.,* UMMZ (9)*"; near Pond, CNHM (1); *Wayne Co.,* UIMNH (1)**."

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*16455 might possibly be a hybrid with *P. cinereus.*

**Nos. 9x.9-881; 54.4-24 through 26 trend slightly towards the aberrant

*"Examined in a different, less detailed study, but probably *c. cinereus.*

**"Examined by D. M. Smith.

Plethodon cinereus serratus: ARKANSAS: *Logan Co.,* Mt. Magazine, CNHM (2, paratypes), ANSP (9); *Montgomery Co.,* Caddo Mts., CNHM (4); *Polk Co.,* Rich Mt., CNHM (29, including the type and 28 paratypes, all but three are topotypes); on Rich Mt., vicinity of Eagleton, CNHM (26); in the mountains E of Mena, GRT (1); *Yell Co.,* SW side of Mt. Nebo, Dardenelle, CNHM (2 paratypes).

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286 DILL AVENUE, FREDERICK, MARYLAND

A MARKING STUDY OF THE SHORT-HEADED GARTER SNAKE IN PENNSYLVANIA.—In July and August of 1956 a marking experiment was undertaken on a population of the short-headed garter snake, *Thamnophis brachystoma* Cope, near Spartansburg, northeastern Crawford County, Pa. The species occurs there in a wide variety of habitats, ranging from relatively dry pastures to the marshes associated with beaver dams. The site of the marking study is a 7-acre rectangular field located on County Road 20061, 4.5 miles southeast of Spartansburg. Because of the unevenness of the terrain, sections of the site are usually extremely wet, especially after prolonged rainfall. In 1937 the field was cleared and planted with young spruces, balsam fir, and larch, which now range from two to ten feet in height. Since 1937 various local plant species (*Solidago, Illinoiensis, Anaphilis*) and aspen have filled in the open spaces. Surrounding the field on three sides is mature white pine, grading into a maple, beech, and hemlock forest. The fourth side is bounded by the road and pasture land. *Storeria o. occipitomaculata* Storer and *Thamnophis s. sirtalis* Linnaeus were taken in association with *T. brachystoma.*

On one of the relatively dry parts of the site is a sheet of corrugated galvanized iron (2′x7′) partially shaded late during the day by a large spruce. By overturning the piece of iron, numbers of *brachystoma* could often be found coiled in the debris beneath. During July and August a total of 14 *brachystoma* were thus taken, measured, marked by clipping caudal scutes (Blanchard and Finster, 1933, Ecology, 14:334-337), and released at the same point. Upon liberation, the snakes invariably crawled back underneath the iron sheet. Marked individuals ranged from 230 to 420 (average 350 mm.) in total length; the sample was thus composed largely of adults. The piece of iron was revisited at irregular intervals during the period of July 5-August 25, usually in late afternoon or early evening. During that time five snakes (35.7%) were recovered, four but once, and one three times, the time span in the latter case being 52 days (the other two recoveries after 12 and 26 days). The single recoveries followed after intervals of 12, 18, 29, and 37 days from the date of initial capture. On several occasions no snakes at all were found under the shelter. No individuals were encountered at any point other than the iron sheet.

Stickel and Cope (Copeia, 1947: 130) concluded that snakes may on occasion have specific home sites in their ranges. The high percentage of *brachystoma* recovered indicates that members of the colony were habitually using the iron sheet as a home site or refuge, probably from heat. Although the iron became hot during the day, there was sufficient space in the debris beneath so that resting snakes were not necessarily in contact with the metal.

The apparent restriction of wanderings far from the refuge was probably due to the species' feeding habits and the time of year involved. A Spartansburg captive fed readily on earthworms. Richmond thinks that *brachystoma* feeds on isopods, earthworms, and slugs (Neil D. Richmond, personal communication). During the season covered by the study, moisture and food would be available in quantity. Furthermore, such wandering stimuli as might exist at mating time would be absent.—*David Klingener, 1140 Lakemont Drive, Meadville, Pa.*

SNAKE VENOMS: HEMORRHAGIC, HEMOTOXIC, OR HEMOPATHIC?—Snake venoms are extremely complex and produce many effects upon animals receiving them, but customarily the effects are conveniently, and on the whole quite properly, classified in two main categories. One of these is the *neurotoxic* response, and the other has in the past been termed either the *hemorrhagic* or *hemotoxic* response. It is our object here to point out that neither of the latter two terms is quite appropriate as a collective for the symptoms involved.

A neurotoxic response is one that involves any sort of chemical impairment of the normal function of any part of the nervous system or of the neuro-muscular functions. Application of the term as a collective for the physiological responses of neural origin from snake envenomation seems quite appropriate and with this usage we find no fault.

The various principles of snake venom that produce an effect upon the blood and/or the vascular systems (*i.e.*, the blood vascular system and the lymph vascular system) cannot, however, *collectively* be termed either hemotoxins or hemorrhagins. Properly defined, as agreed by all medical and standard dictionaries consulted, a hemotoxic response is one that involves chemical impairment of the normal function of any part of the blood, and the blood alone (by common consent including, however, the lymph). Anomalous clotting of the blood and lymph, or their failure to clot, as well as destruction, clumping and other abnormal alterations of the red blood cells, are often important aspects of the hemotoxic response.

Certain principles of the venoms of certain snakes *do* act as hemotoxins, but there are other principles or other effects of the same principles that involve primarily the circulatory vessels. These are hemorrhagins. Properly defined, a hemorrhagic response is one that involves destruction primarily of the endothelium. The endothelium constitutes the very thin lining, a single cell in thickness, of the arteries and veins, and also forms the entire wall of the capillaries. Destruction of the endothelium results in a hemorrhage (escape of blood from its vessels) into adjacent tissues or areas, causing a bruise-like discoloration or ecchymosis. Hemorrhagins also destroy the walls of lymphatic vessels, and in fact are more important in snake venom for this action than for damage to blood vessels, although both phenomena occur.

Most if not all snake venoms containing significant amounts of either hemorrhagins or hemotoxins actually possess both, not one alone. Thus, although any given specific response may quite accurately be regarded as either hemorrhagic or hemotoxic, seldom if ever can the *total* effect upon the circulatory system be described accurately as either hemotoxic or hemorrhagic alone. Nevertheless it is only on rare occasion that emphasis upon either of these aspects of circulatory impairment is desired or is even possible.

We accordingly propose that the total effect upon the circulatory system be termed the *hemopathic* response: one that involves any sort of chemical impairment of the normal function of the circulatory system, including the blood, lymph, and their vascular systems. In turn the hemopathogens may properly be regarded as causing effects of two major sorts: hemotoxic and hemorrhagic. The latter two terms if used at all should be

applied separately, each in its proper, narrow sense.

In proposing the use of the term "hemopathic" in this sense we are assured that the Greek word *hemo* (haima, haema) applies equally well either to the blood itself or to the vascular systems, and that the Greek word pathos refers broadly to any sort of "suffering" condition.

"Hemopathic" is not a new word. It has been defined previously as a "diseased" condition of the blood. One sense of the word "diseased" (impairment of bodily health; sick, ailing) permits the view that the standard definition of the word hemopathic embraces the application here recommended. Even if our present recommendation is regarded as requiring an extension of meaning for the word, at worst the extension could be construed as but slight. We may add as a final gesture that no term of superior philological merit could possibly be desired, or likely be devised.—*Hobart M. Smith and Floyd Boys, Dept. of Zoology and Dept. Health Education, University of Illinois, Urbana.*

CURIOUS FEEDING HABIT OF A BLIND SNAKE, *LEPTOTYPHLOPS*.—Data on the natural food of the blind snakes are few, because the stomach contents have not been recorded. On rare occasions soft-bodied invertebrates have been found, but the absence of identifiable remains in the alimentary tract in most specimens has not been satisfactorily explained. The snakes can scarcely be imagined to eat so rarely as the gut contents suggest.

A very plausible explanation for the absence of identifiable remains was suggested by the behavior of a small *Leptotyphlops phenops* Cope, kindly brought by Mr. Thomas MacDougall from Tehuantepec, Oaxaca, Mexico. The snake was kept alive for several weeks in a small jar containing moist crumbled earth. From time to time termite workers and ant pupæ were dropped into the jar, where the snake's reaction could easily be observed. The ant pupæ never elicited interest, but the snake attacked the termites. It would never attack the cephalic end, even if discovered from that direction; the snake would move about until it approached the posterior end, whereupon it would grasp the abdomen and work its jaws rapidly over the soft body until the chitinous head was reached. Then the snake would writhe energetically and brush the termite from its mouth, with the insect's abdomen completely collapsed. Presumably the abdominal wall had been punctured by the vigorous jaw action, and thereafter the contents removed by suction. This behavior was observed repeatedly, and never was a termite swallowed in its entirety.

This mode of feeding also suggests an adaptive value for the massive mandibles characteristic of the family Leptotyphlopidæ. It furthermore is well calculated for animals having such a slight gape and so limited a bodily accommodation for objects of any size.—*Hobart M. Smith, Department of Zoology, University of Illinois, Urbana.*

Some Noteworthy Reptiles and Amphibians From the States of Oaxaca and Veracruz

By CHARLES M. FUGLER and ROBERT G. WEBB

This paper reports on a collection of reptiles and amphibians from the tropical lowland of Oaxaca north of the Continental Divide and from other localities in Veracruz. The herpetofauna of Oaxaca south of the Continental Divide and of the lowland of Veracruz is relatively well known, but published reports on the intervening area in Oaxaca are few.

The lowland of Oaxaca is at the southern termination of the humid tropics in the Isthmus of Tehuantepec and is a part of the Atlantic Coastal versant (Goldman, 1951, Smithsonian Misc., 115: 226-227). To the north this tropical lowland is continuous with that of Veracruz; to the south it merges with the arid tropics of the Pacific Coastal versant (Goldman, *loc. cit.*). Thorough investigation may show that certain populations occurring on the east and west coasts of Mexico, once thought geographically isolated, are continuous across the Isthmus of Tehuantepec, and therefore are parapatric and conspecific.

Most of the material discussed was acquired in the summer of 1955 by the field party of the University of Kansas Museum of Natural History under the direction of Dr. Rollin Baker. Other specimens were secured by Dr. R. E. Beer of the University of Kansas Department of Entomology and by Mr. R. W. Dickerman, formerly of the University of Kansas Museum of Natural History.

We wish to express our appreciation to Drs. Edward H. Taylor and Hobart M. Smith for advice and verification of certain identifications, to Dr. Henry S. Fitch for certain suggestions, to Dr. E. R. Hall for critical

Pl. 1. *Agalychnis callidryas* (Cope), 2 mi. S Tollocito, Oaxaca. KU 39664, left; KU 39663, right.

perusal of the manuscript, and to Dr. Doris Cochran of the United States National Museum, who kindly compared our specimens of *Eleutherodactylus* with *Eleutherodactylus alfredi* and *conspicuus*.

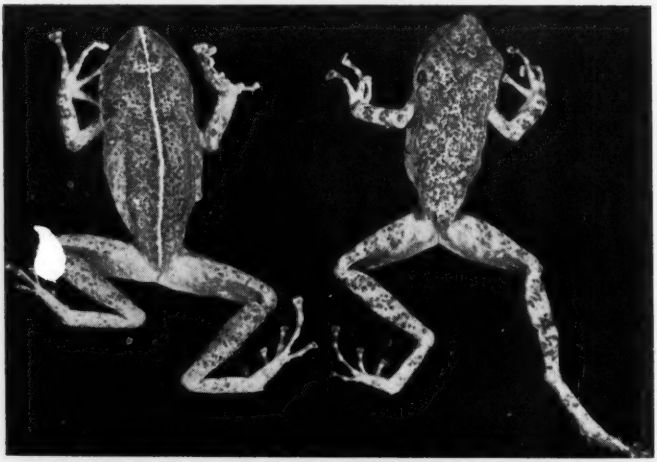
Agalychnis callidryas (Cope).—This arboreal hylid is represented by six specimens, KU 39660-65, 2 mi. S Tollocito, Oaxaca.

In life, brilliant green dorsally, venter and inferior surface of thigh white; in preservative, dorsal green changed to dull blue-gray, brilliant red eye not evident. White vertical stripes, continuous with white venter, extending onto sides between axilla and groin; number and length of lateral stripes variable; small elevated cream-colored dots on dorsum; tibiotarsal articulation reaching anterior level of eye in four specimens, to nostril in another, and to intermediate point in third. This latter character is more variable than reported by Kellogg (1932, U. S. Nat. Mus. Bull., 160: 142), and the canthus rostralis is white, not purplish as described by him. Snout-vent lengths: 43 mm. (1), 46 mm. (1), 47 mm. (2), 48 mm. (1), 63 mm. (1).

The largest specimen, female, was in axillary amplexus when captured. All specimens were discovered in heavy foliage approximately five feet above ground. Our attention was attracted to them by the brilliant reflection of eyes in our headlights. To our knowledge this species has not been reported before from Oaxaca.

Eleutherodactylus alfredi (Boulenger).—Three specimens, KU 26091, 23703-4, are from Teocelo and 2 km. N Matzongo, Veracruz. They are discussed with the following species.

Eleutherodactylus conspicuus Taylor and Smith.—Two females, KU 39673-74, 2 mi. S Tollocito, Oaxaca and seven specimens, KU 26926-32, from 35 km. SE Jesús Carranza, Veracruz, are tentatively referred to this species.



Pl. 2. *Eleutherodactylus conspicuus* Taylor and Smith, 2 mi. S Tollocito. KU 39647, left; KU 39673, right.

Our specimens from Tollocito agree with *conspicuus* of Taylor and Smith (1945, U. S. Nat. Mus. Proc., 95: 567) except vomerine teeth do not extend back to posterior level of choanae, nor near middle of choanae, but to a point slightly anterior to their posterior edge. In this character our specimens are intermediate between *alfredi* and *conspicuus*. Both specimens possess a dark tympanum with a contrasting light center, and a light area on anterior edge of tympanum but not encircling it; they thus approach *alfredi* (*op. cit.*).

The specimens from Matzongo and Teocelo measure 30 mm. to 45 mm. snout-vent, those from Jesús Carranza 29 mm. to 40 mm. Position of vomerine teeth characteristic of *conspicuus* in specimens from Matzongo and Teocelo, intermediate between *alfredi* and *conspicuus* in specimens from Jesús Carranza; tarsal fold present in all; color of tympanum more nearly like that of *alfredi* except in five specimens from Jesús Carranza in which it is intermediate between *alfredi* and *conspicuus* in three, typical of *conspicuus* in two. Length of hind limb, a diagnostic character separating *alfredi* from *conspicuus*, is variable in these specimens. In specimens from Matzongo and Teocelo tibiotarsal articulation, when the leg is laid forward, reaches level of eye in one specimen, snout in another and beyond snout in a third. In specimens from Jesús Carranza tibiotarsal articulation reaches snout in one, external naris in one, and to a point between external naris and eye in five.

Although the Oaxaca specimens seem to be intergrades between *alfredi* and *conspicuus*, we prefer to retain each in full specific standing until the limits of variation within the two species are better known. The status of the Mexican species *spatulatus* Smith, *decurtatus* Taylor, *hidalgoensis* Taylor, *conspicuus* Taylor and Smith, and the extralimital species *xucanebi* Stuart must be examined in the light of the relationship of *alfredi* and *conspicuus*. To our knowledge *conspicuus* has not been reported north of Piedras Negras near the Mexican border in Guatemala (Taylor and Smith, *op. cit.*: 567).

These specimens were taken from large boulders at edge of forest clearing. In the light of our headlights the eyes shone a dull red.

Hyla ebraccata Cope.—A male, KU 39656, of this small species was taken 2 mi. S Tollocito, Oaxaca. Dorsum whitish with small brown punctations; large dark mark on dorsum shaped like that illustrated by Taylor and Smith (1945, U. S. Nat. Mus. Proc., 95: 568); outer angles of dorsal mark extending onto eyelids; light spot near center of dorsal mark; brown band from nostril to approximately midway between axilla and groin, where lateral edges of dark band join lateral edges of dorsal mark. Other characters agree with illustration by Taylor and Smith (*loc. cit.*).

The specific status of this species is discussed by Taylor (1942, Univ. Kansas Sci. Bull., 28: 87). He allocated specimens from Piedras Negras, Guatemala, to *Hyla leucophyllata* (Bereis). Later, Taylor and Smith (1945, U. S. Nat. Mus. Proc., 95: 587) considered the Piedras Negras population specifically distinct from the southern *leucophyllata*, and applied Cope's name *ebraccata* to the northern population.

To our knowledge this species has not before been reported from Mexico.

Hyla microcephala martini Smith.—A small male, 25 mm. snout-vent, 2 mi. S Tollocito, Oaxaca, KU 39655.

Tibia weakly barred, bars consisting of ill-defined stippling; femur not pigmented; tibiotarsal articulation reaching level of eye; length of tibia slightly greater than one-half snout-vent length. Except for above-mentioned characteristics our specimen agrees with the diagnosis of the subspecies by Smith (1951, Herpetologica, 7: 188).

The taxonomic status of Mexican populations is discussed by Smith (*op. cit.*, 184-185). Taylor (1952, Univ. Kansas Sci. Bull., 35: 888-893) discussed the status of Costa Rican and Mexican populations. To our knowledge this subspecies has not been reported previously from Oaxaca; its discovery in southeastern Oaxaca extends the known range southward in the tropical lowland of the Isthmus of Tehuantepec. The higher elevation and more arid conditions prevailing south of the Continental Divide on the west coast probably provide a definitive barrier to the distribution of the subspecies and prevent contact with the west coast population, *sartori* Smith, in the rain forest of Guerrero (Smith, 1951, Herpetologica, 7: 190.

Microhyla usta usta Cope.—Two specimens, KU 39653-54, male and female, 2 mi. S Tollocito, Oaxaca.

Snout-vent lengths, 27 mm. (male) and 30 mm. (female). These specimens agree with subspecific description by Taylor and Smith (1945, U. S. Nat. Mus. Proc., 95: 602-03). Our specimens show no approach toward *u. gadovi* Boulenger, which is found south of the Continental Divide. These microhylids were found under a log and rotting palm fronds in forest clearing.

Pseudemys scripta cataspila (Gunther).—An adult female, KU 41031, and two juveniles KU 40161-2, from Río Playa Vicente near San Andrés Tuxtla, Veracruz, purchased at Alvarado, Veracruz.

In adult specimen, plastron 160 mm. in length; ridge of alveolar surface of upper jaw feebly toothed as are cutting edges of upper and lower jaws; temporal stripe expanded, not in contact with orbit, anterior enlargement separated from orbit by short vertical stripe; each costal plate

Pl. 3. *Hyla microcephala martini* Smith, KU 39655, left. *Hyla ebraccata* Cope, KU 39656, right; both 2 mi. S Tollocito.

with large ocellus surrounding black spot; plastron immaculate except for interrupted smudging along median sutures; ground color of soft parts black.

Two juveniles, KU 40161-62, with orange ocelli on costals; expanded temporal stripes continuous with orbit; definite plastral pattern confined to midventral region.

Lepidochelys olivacea kempi (Garman).—Three juveniles, KU 39555-57, purchased at Alvarado, Veracruz, were said to have come from the immediate vicinity. Another juvenile, KU 39558, was purchased from a native who claimed to have caught it in the surf at Nautla, Veracruz. Three specimens have five pairs of costals, the other with five left and six right. Average measurements of the four specimens are as follows: carapace length, 43 mm.; plastron length, 32 mm.; carapace width, 34 mm.; carapace height, 20 mm.; head width, 14 mm.

Drymarchon corais melanurus (Duméril, Bibron, Duméril).—A large male, KU 39733, DOR 16 mi. S Sayula, Veracruz has: scale rows, 19-17-15; ventrals, 197; caudals, 64; supralabials, 8; infralabials, 9-8; preoculars, 1; postoculars, 2; antepenultimate supralabials contacting anterior temporals on both sides; loreals, 1.

The specimen agrees with *melanurus* in: dorsum brown anteriorly and darker brown posteriorly; antepenultimate supralabials in contact with postoculars. It approaches *orizabensis* (Dugès) in: anterior part of belly heavily pigmented; all labials black-edged. In number of ventrals (197) and caudals (64) it is nearer *orizabensis* than *melanurus*. The caudal count is below those listed by Smith (1941, Journ. Washington Acad. Sci., 31: 477). Smith lists one specimen with labials edged in black anterior and posterior to eye; he considers it an intergrade between *melanurus* and *orizabensis*.

Natrix rhombifera werleri Conant.—Three males DOR 10 mi. and 15 mi. N Alvarado, Veracruz, KU 39697-99.

Scale rows in each specimen, 26-25-21; ventrals, 139, 139, 143; caudals, 69, 69, 67. The following were the same in each specimen: supralabials, 8; infralabials, 11; preoculars, 1; postoculars, 4-3.

Pituophis catenifer sayi (Schlegel).—A male, DOR, KU 39703, 2 mi. ESE Boca del Río, Veracruz.

Scale rows, 33-33-24; ventrals, 224; caudals, 69; supralabials, 9; infralabials, 14-13; preoculars, 2; postoculars, 5; loreals, 1. Prefrontals anomalous, right secondarily divided, secondary sutures not reaching posterior margin of prefrontal juncture; fifth supralabial entering orbit, sixth prevented from entering by lowermost postocular or subocular, probably segmented from sixth supralabial; no azygous scale. Dorsal blotches 52; tail blotches 15. Rostral not twice as long as broad. Stull (1940, U. S. Nat. Mus. Bull., 175: 91-105) states that length of rostral in proportion to its width is a significant character in the recognition of *sayi*.

Klauber (1947, Zool. Soc. San Diego Bull., 212: 12) reported *sayi* from ¾ miles inland from Tamesí River, in Veracruz or Tamaulipas, having two labials in contact with eye, although it had four prefrontals. Our specimen extends the known range of *sayi* approximately 350 miles south of previous record.

Coleonyx elegans Gray.—Three males, KU 39677-78, 40145, 2 mi. S Tollocito, Oaxaca.

Femoral pores 10, 7, 10; supralabials, 7-8, 7-7, 7-7; internarial scales, 9, 7, 7; scales touching mental, 9, 5, 5; supranasals, in contact 2, separate 1; claws, visible in all; snout-vent length, 95 mm., 98 mm., 87 mm.

We use the term supranasal in same sense as did Smith and Taylor (1950, U. S. Nat. Mus. Bull., 199: 42). Relationship of the supranasals is thought by Klauber (1945, Trans. San Diego Soc. Nat. Hist., 10: 196, 206) to be of subspecific value. One of the three, therefore, is referable to *nemoralis* Klauber, the subspecies of the Pacific versant, and the remaining two to *elegans* of the Atlantic versant. Our specimens are probably intergrades between *elegans* and *nemoralis*.

These specimens were taken at night on the floor of the forest in dense undergrowth. The stomach of one contained a large arachnid, and exoskeletal remains of Coleoptera were present in the second.

Anolis lemurinus bourgeaei Bocourt.—Two males, KU 40148-49, 2 mi. S Tollocito, Oaxaca, represent northernmost record for the subspecies.

Ventral scales strongly keeled and larger than dorsals; distance from tip of snout to posterior border of auricular opening less than length of tibia; dewlap large and extending onto chest, in preservative reddish; middorsal scales distinctly larger than adjacent scales; snout-vent 53 mm. and 57 mm. respectively; dorsal pattern on one specimen composed of a series of small hour-glass-like marks along mid-dorsal line; semicircles separated from occiput by three scales; supraorbital semicircles separated by one scale row in each. Stuart (1955, Misc. Publ. Zool. Univ. Michigan, 91: 18) states that *bourgeaei* usually has two or three scales separating supraorbital semicircles.

Sceloporus malachiticus internasalis Smith and Bumzahem.—Two females, KU 40146-47, 2 mi. S Tollocito, Oaxaca.

In life, color greenish-yellow dorsally and white ventrally, anterior shoulder patches distinct; in preservative, dorsum dull gray-green tending toward brown, indistinct black spots on dorsum, tail and digits banded.

Our specimens agree with the description of the subspecies by Smith and Bumzahem (1955, Herpetologica, 11: 118).

This lizard was common high on the trunks of larger trees. The somber cast of the females and their extreme wariness made them difficult to detect.

LOCALITIES

All place names listed in this report are found on the Mexican and Central American Map prepared by the National Geographic Society in 1953, and these names are listed in the *Index to Map of Hispanic America, Volume II, Geographical Names in Mexico.* The name "Tollocito" may appear on the mentioned map as "Tolosa" or "Tollosa." It is on the Trans-Isthmus highway on the banks of Río Jaltepéc in the state of Oaxaca, eight kilometers (by river) from the town of Jesús Carranza, Veracruz.

MUSEUM OF NATURAL HISTORY, UNIVERSITY OF KANSAS, LAWRENCE, KANSAS.

A New Race of the Iguanid Lizard *Leiocephalus carinatus* from Cayman Brac, B.W.I.

By George B. Rabb

From a recently completed study of variation in some 900 specimens of *Leiocephalus carinatus* I have concluded that most of the races of this species are well founded. I wish to make here one of the few taxonomic changes which seem called for, involving an obviously distinct taxon in want of a name. In recognition of the contributions that Major Grant's collections and papers have made to herpetological knowledge of the West Indies, it seems fitting to designate this form as

Leiocephalus carinatus granti, subsp. nov.

Holotype, UMMZ 114494, an adult male collected by Chapman Grant in March or April, 1937, on Cayman Brac, British West Indies. Collector's number 2412. *Paratypes.* UMMZ 85926 (5); MCZ 6224 (2), 10604-16, 45126-30; USNM 81742-9, 107966-71; all from Cayman Brac.

Diagnosis. A race of *Leiocephalus carinatus* distinguishable from all others in its combination of a tail ringed with white and dark brown; a light gray-brown dorsal color, with slightly darker transverse bars; a relatively light colored head, with little or no dark spotting; and a low number of dorsal crest scales from head to level of vent (mean about 46 in males, 47 in females).

Description of holotype. Dorsal head scales very slightly ridged. Frontonasals separated; prefrontals three, forming a continuous row; frontoparietals six, forming a complete row; parietals in contact; supraorbital semicircle scales continuously separating supraoculars from more medial scales; six large supraoculars; labioloreal series not continuous with temporals; about nine temporals in vertical line from posterior supralabials to paraparietals; one small and three large anterior auricular scales.

Forty-six dorsal crest scales in distance from posterior edge of parietals to level of vent; about 34 scales around the body at a point midway between the limbs; and 24 tricarinate subdigital scales on the fourth toe.

Head length contained in snout-vent length about four times; tail length about one and a half times as long as snout-vent length. Head width about seven-tenths of head length. The measurements in mm. are: snout-vent length, 95.2; tail length, 150; snout-ear length, 24.0; head width, 16.8.

Coloration in alcohol: Dorsum gray-brown with ill-defined transverse bands of ground color three to four scales in width separated by single rows of light-tipped scales. Head a light green-brown with a faint darker spot on one of the paraparietals. Throat light, with an anterior dark bar on the first chinshields, followed by three similarly colored V-shaped markings, the apices of which are incomplete, and these in turn followed by two somewhat fragmented longitudinal dark lines extending onto the chest. No lateral dark bars. Tail with very dark brown and white rings posteriorly and incomplete rings of lighter brown anteriorly. Posteriorly, the dark bands are about three or four scales and the white bands two

scales wide on the caudal crest.

Remarks. A treatment of variation in scutellation of this and other taxa of the *Leiocephalus carinatus* complex will be published elsewhere. It may be noted here that *granti* exhibits little variation in the diagnostic characters.

Differences between this subspecies and *varius* of Grand Cayman have been given by Grant (1940, Bull. Inst. Jamaica, Sci. Ser., 2). In this paper he also gives a detailed description of the specimen which I have designated the holotype of *L. c. granti.* In lack of spotting on the head and low number of dorsal crest scales, *L. c. granti* resembles the recently described *L. c. aquarius* (Schwartz and Ogren, 1956, Herpetologica, 12:91-110) of the southern shore of Oriente Province, Cuba. The strikingly ringed tail and lack of lateral bars suffice to separate *L. c. granti* from this race.

My thanks are extended to authorities of the following institutions for loan of materials: Museum of Comparative Zoology (MCZ), U. S. National Museum (USNM), and University of Michigan Museum of Zoology (UMMZ). I also gratefully acknowledge suggestions by Dr. Charles F. Walker of the latter institution.

CHICAGO ZOOLOGICAL SOCIETY, BROOKFIELD, ILLINOIS.

THE BREEDING GROUNDS OF THE LUTH AND THE RIDLEY.—The receipt of a Leader Exchange Award from the State Department of the United States in 1956 enabled the writer to travel around the world and afforded opportunities for a number of novel observations, some of which are recorded herewith.

The two most prolific breeding grounds of *Dermochelys coriacea* Linné appear to be Ceylon, and certain parts of the east coast of Malaya. Other breeding grounds which are not particularly well known appear to be off the coast of Florida, where newly hatched young have been secured and taken to the "Seaquarium" at Miami.

Lepidochelys olivacea kempi (Garman) has hitherto withstood all attempts to locate its breeding grounds. The only information available up to the present time has been the solitary young individual captured at the Azores (Deraniyagala, 1939, Bull. Inst. Oceanograph, Monaco, 772: 1-4).

While visiting the University of Kansas, through the kindness of Prof. E. H. Taylor and Mr. John Legler the writer was permitted to examine four hatchlings of this subspecies recorded by Fugler and Webb in this issue.

The coloration is almost black in all of these hatchlings, closely similar to equally young examples of the nominate subspecies except that the white border of the flipper is represented by only a short length of light gray along the posterior edge of the top of the fore flipper. The carapace margin possesses only a feeble brownish gray outline along the anterior half and no white margin.

These records strongly suggest that an intensive search will prove the validity of the local reports of the nesting of both the Ridley and the Luth upon the beaches neighboring Miami.—*P. E. P. Deraniyagala, Director, National Museums, Colombo 7, Ceylon.*

Some Misconceptions Regarding the Eastern Coral Snake, *Micrurus fulvius*

By Wilfred T. Neill

The literature would lead one to believe that the eastern coral snake, *Micrurus fulvius,* is mostly nocturnal. Thus, Conant and Bridges (1939, What Snake Is That?: 135) remarked of this species, "Rarely is it seen in the open except at night, after rains or during the breeding season in early spring." Cochran (1943, Poisonous Reptiles of the World: 4) stated that coral snakes "come out of their burrows at night or after a rain . . ." Pope (1944, The Poisonous Snakes of the New World: 7) described coral snakes in general as being "secretive snakes that seldom wander abroad during daylight hours." Werler (1950, Texas Game, Fish and Oyster Commission, Bull. 31: 27) described *M. fulvius* as "coming to the surface at night or after a warm rain . . ." Like statements have been made by others. I suspect that some of these remarks stem from the writings of the late Raymond L. Ditmars, who, in his 1907 Reptile Book and elsewhere, declared that the coral snake ventures abroad by night or after rains.

Workers who are familiar with *Micrurus fulvius* in nature do not regard it as nocturnal. Dr. Archie F. Carr stated (personal communication) that he had encountered roughly 100 coral snakes in Florida, and that only one of these was abroad at night. The single nocturnal example was found under unusual circumstances; it was on floating vegetation in a pond (Carr, 1940, Univ. Fla. Pub., Biol. Sci. Ser. 3 (1): 94). Mr. E. Ross Allen stated (personal communication) that he had collected approximately 75 coral snakes in Florida, none of them at night. The late John K. Strecker was emphatic about the diurnality of this species. He commented (1927, Contr. Baylor Univ. Mus., No. 10: 11-12), "I have never found a specimen abroad at night . . . I have captured and handled a great many specimens. All of those that I have caught were in the open (and) the majority, if not all of them, were collected on bright sunshiny days."

My own observations accord with those of Carr, Allen and Strecker. During the past ten years, 121 coral snakes were caught by me or by acquaintances from whom I could learn the circumstances of collection. Of these snakes, only one was encountered at night. This one I found crossing a paved road near Ocala, Florida, about 8:30 P.M. A house cat was following the snake and pawing at it.

There are a few published records of coral snakes found at night. A specimen was collected in Tampa, Florida, about 10:00 P.M. (Seaton, 1949, Herpetologica, 5 (6): 149). Near Corpus Christi, Texas, no less than ten coral snakes were found at night, crossing roads (J. D. Ruick, 1948, Herpetologica, 4 (6): 215). I have talked with Mr. Ruick, who said that the snakes were found during the early hours of the night, and that daylight temperatures in the area were very high at the time. The plant cover was mostly grass and mesquite, and the humidity was extremely low. Perhaps local weather conditions precluded diurnal foraging. Within my experience, a diurnal snake does not become nocturnal even during periods of adverse weather, but there might be some exceptions.

At any rate, the coral snake is largely diurnal in Georgia and Florida. It usually prowls in the early morning, from shortly after sunrise to about 9:00 A.M. It is most often seen on bright, sunny mornings. Occasional specimens are found later in the day. I have never encountered a coral snake in the late evening, although it would not be surprising to find one abroad at such a time. Most snakes that prowl in the early morning occasionally do likewise in the evening; and there is one record of a Texas coral snake, *Micrurus fulvius tenere,* which was found in the evening (Gloyd, 1938, Herpetologica, 1 (5): 121).

In Florida, the failure to find coral snakes at night does not reflect the diurnality of the collector. In this state it is customary to collect largely at night.

Another misconception relates to the habitat of the eastern coral snake. It is often said that this reptile frequents deep, shady woods, where the ground is covered by thick humus and where crepuscular conditions prevail even at midday. Actually, in South Georgia and most of Florida, the coral snake frequents a variety of situations but is most common in dry places where the ground is open or brushy but not heavily vegetated. The optimum habitat in Central Florida seems to be the plant association called turkeyoak and longleaf pine *(Quercus laevis* and *Pinus australis).* This is a xeric association developing on sandhills. The arboreal vegetation is open, permitting considerable sunlight to reach the ground. The herbaceous vegetation is seldom very dense; bare patches of sand are usually visible, interspersed with areas of comparatively dry, leafy cover. The association has been described by Carr (*op. cit.:* 14-15) under the name "high-pine." The *Q. laevis* and *P. australis* association is probably drier even than rosemary scrub (Laessle, 1942, Univ. Fla. Pub., Biol. Sci. Ser. 4 (1): 31), and is thus the driest major plant association in Florida and South Georgia.

In Central Florida I have also found coral snakes to frequent two other xeric associations: scrub and liveoak hammock. In the latter association this snake sometimes inhabits the layer of dry, dead leaves beneath the larger oak trees. In both Central and North Florida the coral snake is moderately common in slash pine and wire-grass flatwoods. In Georgia it is to be found about lake margins, in spots where the ground is sandy and but sparsely vegetated. Lake margins are frequented in the Gainesville area of North Florida, also, to judge from the remarks of Carr and Goin (1955, Guide to the Reptiles, Amphibians and Fresh-water Fishes of Florida: 297). Mesic hammock is likewise inhabited. In extreme southern Florida, the nominal race *Micrurus fulvius barbouri* frequents tropical hammock. Outside Florida, habitat notes on the coral snake are few. Cook (1954, Snakes of Mississippi: 31) stated that in Mississippi it is found about old logs on sand ridges. In Louisiana it is "confined chiefly to the pine lands and sandy creek bottoms" (Viosca, 1933, Louisiana Out-of-Doors: 101). Ruick (*op. cit.*) found the Texas subspecies in areas of dry, loose sand where the vegetation was mostly grass and mesquite. At the westernmost locality for the species, in Terrell County, Texas, the snake was found in a liveoak association bordering a stream (Milstead, Mecham and McClintock, 1950, Texas Jour. Sci., No. 4: 556).

Certain harmless snakes are colored much like the venomous coral snakes. Some people have interpreted this circumstance as mimicry. Opponents of the mimicry theory have declared that snakes of the genus *Micrurus,* and their alleged mimics, are largely nocturnal (Dunn, 1954, Evol. 8: 97; Brattstrom, 1955, *ibid.,* 9: 218). This generalization is very questionable. As pointed out, *M. fulvius* is usually diurnal. One of its supposed mimics, the scarlet snake, *Cemophora coccinea,* occasionally prowls at night, but is much more often encountered in the morning hours and somewhat less often in the evening. Some of the tropical coral snakes, including *M. nigrocinctus, M. diastema* and *M. affinis,* are at least partly if not largely diurnal.

Yet another misconception relates to the size of the coral snake. Schmidt and Davis (1941, Field Book of Snakes of the United States and Canada: 276) gave the maximum length as 39 inches. Pope (1955, The Reptile World: 207) made a similar statement. Actually, much larger specimens are fairly common, at least in Central Florida. In the vicinity of Silver Springs, Marion County, Florida, I have collected four examples between 40 and 42 inches in length. Each year the Reptile Institute receives a few coral snakes approximately 42 inches in length, and specimens larger than this are rare. The largest I have personally measured was 1120 mm., or slightly more than 44 inches, in length. It was collected about 3 miles north of Silver Springs. Seaton (*op. cit.*) mentioned a specimen 1117.6 mm. in total length, taken in Tampa, Florida. According to E. Ross Allen (personal communication), the largest coral snake received by him measured 47½ inches. This same figure is given by Oliver (1955, The Natural History of North American Amphibians and Reptiles: 301) as the maximum size of the coral snake, and I believe Oliver's figure was based on Allen's specimen. This giant of its kind has also been the basis for remarks by Allen and Neill (1950, Fla. Wildlife, Sept.: 14) and by Neill (1952, Fla. Naturalist 25 (1):11).

There may be some regional variation in the size of the coral snake. The average size is large in Marion County, Florida, but small in the southern tip of the state where the nominal race *Micrurus fulvius barbouri* occurs. With two exceptions, all the coral snakes received from extreme southern Florida have been under 30 inches in length. The exceptions, both from Dade County, measured 36 and 37½ inches, respectively. Werler (*op. cit.*) considered 42 inches to be the maximum length of the Texas population.

There appears to be disagreement among authors as to the number of eggs laid by *Micrurus fulvius.* Oliver (*op. cit.*), probably following Schmidt and Davis (*op. cit.*), indicated that only two to four eggs were produced. However, Ditmars (1936, Reptiles of the World: 222) mentioned a clutch of 11 eggs. Werler (1951, Zoologica 36 (1): 46) noted that a Texas coral snake laid 9 eggs. Stickel (1952, Venomous Snakes of the United States and Treatment of Their Bites: 10) observed that the species "lays from 2 to 12 eggs, usually fewer than 6." Allen and Neill (*op. cit.*) stated, "The whitish, soft-shelled eggs, usually less than a half-dozen in number, are deposited in rotting logs or debris. They require from 2 to 3 months to hatch, and the newly emerged young, 7 or 8 inches in length, resemble the parents but are paler in color." This comment, and my subsequent ones (Neill, *op. cit.*), were based on ob-

servations of Central Florida specimens. Subsequently I collected a coral snake which laid 13 eggs in captivity. It was taken at Silver Springs, Florida. This is the largest clutch known to me. Telford (1955, Copeia 3: 258) has recently described a clutch of 7 eggs.

The temperament of the coral snake has also been a matter of dispute. As Schmidt and Davis (*op cit.*: 276) put it, "no one knows why or when they will bite." In my opinion the good nature of the coral snake has been over-emphasized. It is true that many specimens will not strike like a crotalid snake. Nevertheless I have seen occasional ones lunge out, even though they had not been touched; and Carr (*op. cit.*) has described how a coral snake struck a man's boot. If picked up gently, a coral snake may not try to bite. If pinned down, however, most coral snakes will bite at and chew on the restraining object. Once aroused, they are quite likely to strike. Having seen hundreds of specimens, many of them handled daily by Reptile Institute personnel, I regard the species as touchy and ill-tempered if in any way restrained.

Yet another problem relates to the toxicity of coral snake venom. Earlier workers, such as E. D. Cope (1900, The Crocodilians, Lizards and Snakes of North America: 1119) and S. Weir Mitchell (1889, Century Mag., 38: 505), regarded the reptile as harmless to man and larger animals. Later workers have taken the opposite view. Thus, Schmidt and Davis (*op. cit.*) stated that the percentage of fatalities from coral snake bite is higher than that from rattlesnake bite. Gloyd (1938, Snake Poisoning in the United States: a Review of Present Knowledge: 2; 1944, Texas Geographic Mag. 8 (2): 11) remarked that the "proportion of fatalities (from coral snake bite) is relatively high." Pope (1955: 207) commented, "the percentage of fatalities from the bites (is) relatively high." Several authors have claimed that coral snake bite is fatal in 7 out of 10, or 8 out of 10, cases. A more conservative estimate is that of Stickel (*op. cit.*:17), who stated that a 20% mortality rate was "now believed to be approximately correct." Stickel's figure may be derived from the writings of E. Ross Allen and myself; for in several places we have commented that, of 15 coral snake bites known to us, only three were fatal. This comment can now be amplified.

For many years the Reptile Institute subscribed to a clipping service which provided newspaper accounts of snake-bites. Following each bite, a brief questionnaire was sent to the victim, to his physician, or to the hospital where he was treated. Information was requested as to how, when and where the accident happened; the age, weight, sex and race of the victim; the kind of snake involved; the part of the body that was bitten; the first aid and later medical treatment received; and the outcome of the case. At the end of each year a check was made with the Bureau of Vital Statistics for any cases that might have been overlooked. In this way more than 600 case histories of snake-bites were accumulated. Some of these have been reported by Andrews and Pollard (1953, Jour. Fla. Med. Assn. 40: 388-397), and certain aspects of the accumulated data have been discussed in semi-popular vein (Allen and Neill, 1956, Sports Afield 135 (3): 61-63, 138-141); but the coral snake bites have not been described in detail. They may now be taken up in chronological order.

(1) T. L. R., Dinsmore, Florida. Adult male, age not recorded. Bitten November, 1934. Mr. R. picked the snake up and was bitten on

the hand. He immediately incised the fang punctures and applied suction; then sought and received hospital treatment of unspecified nature. Recovered.

(2) T. W., Orlando, Florida. Male, age 17. Bitten May, 1935. Mr. W. was carrying the snake in a paper bag; when squeezed, the snake bit through the bag. Received antivenin; recovered.

(3) H. C., Miami, Florida. Male Negro, age 29. Bitten July, 1936. Mr. C. was working in a field, and was bitten twice by a small snake which he neither saw nor heard. It is likely, but not certain, that the reptile was a coral snake. Mr. C. was taken to the hospital, where he received first aid and an injection of rattlesnake serum, about 1½ hours after the bite. He died about 60 hours after the bite.

(4) T. J. K., Jacksonville, Florida. Male, age 39. Bitten April, 1939. Mr. K. was bitten on the finger; and, believing the snake to be harmless, he refused treatment. The following morning he was found in his bed, paralyzed. He died 23 hours after the bite.

(5) D. M., Tampa, Florida. Female, age 14. Bitten June, 1939. Miss M., bare-footed, was bitten beside the little toe of the right foot. She was sitting on the porch with her legs hung over the side when the accident happened. The snake was killed and taken to the hospital along with the victim. Miss M.'s foot became swollen, discolored and painful, but other ill effects were not noted. Apparently medical treatment was deemed unnecessary.

(6) — K., Lacota, Florida. Male, age 60. Bitten August, 1939. Mr. K., a snake hunter, was bitten on the finger, but the snake's fangs failed to penetrate the skin. No first aid or other treatment was given, and there were no ill effects.

(7) — —, St. Petersburg, Florida. Male infant, age 1. Bitten November, 1939. Details of the bite are lacking. The infant recovered, and his survival was described in a local newspaper as "a modern medical miracle."

(8) J. T. E., Camp Blanding, Florida. Adult male, age not recorded. Bitten in 1943. The snake was in Mr. E.'s bed. It bit Mr. E. on the first finger of the right hand, and hung on until pulled off. The fang marks were incised and suction was applied. No other treatment was given, and no ill effects were noted.

(9) F. W., Red Bank, New Jersey. Male, age 13. Bitten December, 1943. The boy had two Texas coral snakes, which he took to school in jars. He loosened the lid of a jar, and a snake started to emerge. He tried to force it back, and it bit him on the right index finger. A rubber band was placed around the boy's wrist. The victim was rushed to the hospital, where two deep longitudinal incisions were made at the site of the bite. Ethyl chloride was used as a local anaesthetic when the incisions were made. The bitten finger was then soaked in 1:5000 solution of potassium permanganate. Subsequently advised to discontinue the potassium permanganate, the attending physician substituted saline solution. About 4¼ hours after the bite, 10 cc of antivenin, Pasteur "C", were administered intravenously. Two hours later, another 10 cc were administered in similar fashion. After another five hours had elapsed, the boy was given 10 cc of Pasteur "AN" intravenously. About 3½ hours after this injection, the boy was given 10 cc of Pasteur "AO" intravenously. About

2½ hours later the victim received a fifth injection, 10 cc of Sharp and Dohme "Cascabel" (South American rattlesnake) antivenin. It was administered in the right subscapular space. This fifth injection produced great pain and a skin reaction. The boy showed almost no local symptoms upon arrival at the hospital. He was flushed, perhaps from excitement. During the next few hours he complained of pains in his finger, perhaps from the incisions. About 4¼ hours after the bite he showed signs of respiratory difficulty and occasional spasmodic twitchings of the entire body. About 6¼ hours after the bite, respiration was markedly affected, and the patient was having frequent spasms of all-over twitching. He also doubled up as if in great pain, but said the only pain he felt was in his finger. The symptoms decreased slightly after the second injection of antivenin. About 24 hours after the bite, the boy seemed well on the way to recovery. However, 4 days after the bite he developed a severe serum reaction which persisted for about 24 hours. He was released, completely cured, 9 days after the bite. Symptomatic treatment had included caffeine sodium benzoate, luminal, coramine, and 1500 units of tetanus antitoxin; an oxygen mask had been used for about 8 hours, its use beginning about 5¼ hours after the bite.

(10) E. F. T., Eureka, Florida. Male, age 67. Bitten February, 1945. Mr. T. picked up the snake and was bitten on the index finger. The bite stung and drew blood, but there were no other ill effects and no treatment was deemed necessary.

(11) J. B. R., Fort Christmas, Florida. Female, age 14 months. Bitten March, 1946. The child was bitten while playing on the kitchen floor, beneath a table. A house cat was seen to pounce on something beneath the table, but no one realized that the child had been bitten by a snake. Her finger stiffened, and she was taken to a doctor who wrote a prescription but apparently did not recognize the injury as snake-bite. The child continued to cry, as if in great pain, and was then taken to a hospital. In the meanwhile, the head of the offending reptile was discovered; the body had been eaten by the cat. The child died the following morning.

(12) L. C. B., Orlando, Florida. Female, age 42. Bitten July, 1948. Mrs. B. stepped on the snake in the kitchen of her home; she was barefooted at the time. The reptile bit her on the under surface of the little toe. No first aid was given, but she reached a hospital in 40 minutes. A constricting band was applied and the vicinity of the bite was excised. About 4½ hours after the bite, 10 cc of cobra antivenin were given. About 24 hours after the bite, the woman was released from the hospital, and there were no further complications.

(13) C. H., Clearwater, Florida. Male Negro, age 49. Bitten September, 1948. Mr. H. was bitten on the left index finger as he was working in a citrus grove. He was taken to the hospital, and was partially paralyzed by the time of arrival. Pain, followed by numbness, progressed up the arm to the shoulder. Then the hand began to swell and was placed in hot Epsom salts packs. The patient experienced a sensation of numbness and pressure in his chest, as though from a heavy weight thereon. Nausea and abdominal cramps developed. The man was given various stimulants, and finally received cobra antivenin. The day after the bite he was still nauseated and his left leg was cramping severely. The

second day after the bite, he was still nauseated and very drowsy. The third day after the bite, he was able to retain food; the pain had lessened and the numbness had vanished. Recovered.

(14) W. A., DeLand, Florida. Male, young adult. Bitten June, 1950. Mr. A., a herpetology student, was attempting to photograph a refractory coral snake, and found it necessary to stun the reptile. Insufficiently stunned, the snake bit Mr. A. on the finger. Within 45 seconds a constricting band was applied and the fang marks were incised deeply. Bleeding was encouraged, by suction and rubbing, for about 1½ hours. No ill effects were noted during the first two hours after the bite, except for pain probably brought on by the incision. The finger became numb, but the numbness was attributed to the rubbing and incision rather than the venom. Later, a swelling developed in the axilla, and became painful. About 24 hours after the bite, the joints of the bitten finger, and of the arm generally, were sore. No other ill effects were noted.

(15) R. E. G., Lake Alfred, Florida. Male, age 16. Bitten April, 1953. The boy picked up a coral snake in the garden of his home, and the reptile bit him on the finger tip. The venomous nature of the snake was not realized at the time, and no first aid was given. About 1½ hours after the bite, the boy was obviously ill, and was taken to a hospital where oxygen was administered. The boy died 5 hours after the bite.

(16) L. T., Miami, Florida. Male, age 31. Mr. T. was bitten on the hand while at work on a construction job. The venomous nature of the snake was recognized by a fellow worker. A tourniquet was applied immediately, and the fang punctures were incised. The bitten arm began to pain and swell. Cobra serum was administered, and the pain and swelling were rapidly alleviated. Several days later Mr. T. suffered what was called a "relapse," but eventually recovered.

(17) C. L. H., Ocala, Florida. Male, young adult. Bitten in 1955. Mr. H. was trying to catch a coral snake and was bitten on the hand. He felt a slight burning pain from the bite, but developed no further symptoms.

(18) E. T. R., Silver Springs, Florida. Male, age 24. Bitten September, 1956. Mr. R. was holding the snake by the tail. The snake's fangs grazed Mr. R.'s hand, each leaving a small, red scratch. Apparently no venom was injected; no ill effects were felt.

(19) C. D., Tampa, Florida. Male, young adult. Bitten October, 1956. Mr. D., a snake hunter, had caught the reptile and was holding its head; but it managed to twist and sink one fang into the tip of Mr. D.'s index finger. Mr. D. tied a string tightly about the base of the finger and incised the fang puncture. He reached a hospital about 40 minutes after the bite. The bitten finger was further incised and the constricting string removed. Mr. D. was given 10 cc of coral snake serum, and was also given acromycin. He was instructed to keep the bitten hand immersed in ice packs. About 5 hours after the bite Mr. D. abandoned the treatment. At that time his arm was stiff and sore, perhaps from the antivenin. No further ill effects were noted.

(20) Andrews and Pollard (*op. cit.*) described a case of coral snake bite in Florida. A boy stepped on the reptile, then picked it up and swung it about. The snake's fangs struck the boy's finger, producing a

stinging sensation. No symptoms developed, and it is likely that no venom was injected.

In Columbia County, Florida, there was a 21st bite, about which I could learn almost nothing. Of the above 21 cases, only two were actually seen by me. Information on the remainder is second-hand, gathered in the fashion previously outlined.

The literature dealing with coral snake bite is a bit more extensive than is sometimes realized. True (1883, Amer. Nat. 17: 26-31) reported four such bites, two of them terminating fatally. Yarrow (1887, Med. News, 50: 624) further discussed one of these cases. Coe (1891, Sci. Amer., 64: 401) and Loennberg (1894, Proc. U. S. Nat. Mus., 18: 334) described a fatality from coral snake bite in Florida; and the latter author mentioned several other cases. Stejneger (1895, The Poisonous Snakes of North America: 353-354) supplied additional data on bites. Barbour (1921, Occ. Pap. Mus. Zool. Univ. Mich., No. 131: 6) also noted a death from coral snake bite in Florida. According to Baxter (1930, Augusta Chronicle, August 17), a certain H. Parkyn, "the first Confederate soldier to be killed during the War Between the States," died of coral snake bite. The offending reptile is preserved in the Augusta (Georgia) Museum. Githens (1935, Sci. Monthly, 41: 165) tabulated six cases of coral snake bite in the southern United States, but provided no other data. Gloyd (1938, Herpetologica, 1 (5): 121) described a coral snake bite in Texas; and Werler and Darling (1950, *ibid.*, 6 (7): 197) reported another from that state. Swartzwelder (1950, Amer. Jour. Trop. Med. 30: 575-587) studied snake-bite cases in Louisiana. Andrews and Pollard (*op. cit.*) included one case of coral snake bite in their study of ophidiasis in Florida. A manuscript by E. Ross Allen (1953, Statistics Collected on 172 Cases of Snake Bite in Florida from 1947-52) is on file at Wyeth Laboratories in Philadelphia, according to Wood (1954, Amer. Jour. Trop. Med. Hyg. 3 (5): 939). Allen and Neill (1950, 1956) commented briefly on the incidence and mortality rate of coral snake bite in Florida.

It is clear that the coral snake is capable of delivering an extremely dangerous bite; but, probably on account of its inefficient fang mechanism, often fails to do so. Thus the percentage of fatalities from coral snake bite is not extremely high. (The eastern diamondback rattlesnake, *Crotalus adamanteus*, had a mortality rate of about 40% during the 1930's and 1940's. This rate was twice as high as that of the coral snake during the same period.) It is also clear that a large percentage of coral snake bites result from carelessness; in at least half of the cases described herein, the snake was deliberately picked up, touched, or otherwise manipulated.

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A New Lizard of the Genus *Lepidophyma* from Veracruz, Mexico

By John E. Werler and Frederick A. Shannon

In a collection of reptiles and amphibians made in the Los Tuxtlas region of southern Veracruz, Mexico, during 1953 and 1954, are several lizards of the genus *Lepidophyma* that apparently represent a distinct and undescribed population. Specimens used in this study are for the most part in the personal collection of the junior author at Wickenburg, Arizona, and may be identified by the abbreviation FAS.

A complete report of the reptiles assembled during the two expeditions is in preparation. This will include acknowledgements for the loan of specimens and assistance in the field.

We propose the new species be known as:

Lepidophyma tuxtlae sp. nov.

Holotype. FAS No. 10550, a subadult female from the lower slopes of Volcán San Martín, Veracruz, elevation 2,500 feet; collected by John E. Werler and Jack Reid on February 14, 1953.

Paratypes. Nos. 10548, 10549 and 10553, same data as holotype, except the last from 3,000 feet elevation; Nos. 10551-2, from near Tula, Veracruz, elevation about 400 feet, February 8, 1953; Univ. Ill. Mus. Nat. Hist. Nos. 40285-6, Rancho El Tular, 5 mi. N. San Andres Tuxtla, Veracruz, Dec. 1, 1955, Dave A. Langebartel; UIMNH Nos. 35449, 35463-4, same loc., H. Barden and I. L. Firschein, 1952-3.

Diagnosis. A black *Lepidophyma* with small white spots, differing from other described members of the genus in having the enlarged tubercles of each paravertebral row contiguous and subequal. Four rows of granules between enlarged paravertebral series; tubercles in lateral vertical rows strongly differentiated from adjacent granules; a median prefrontal present; first loreal higher than posterior nasal; sixth supralabial larger than seventh; only first pair of chin shields in contact medially; femoral pores 11-14 in a row; 40-42 ventrals between gular fold and anus; three dorsal and two ventral whorls of small scales separating enlarged scales at middle of tail.

Description of holotype. Head greatly flattened; rostral plate barely visible from above; anterior nasals meeting middorsally behind rostral; bordering these scales posteriorly a large frontonasal contacting median prefrontal and lateral prefrontals dorsally and nasals and anterior loreal laterally; a pair of lateral prefrontals widely separated by a median prefrontal; a pair of frontals between orbits; these followed by a pair of frontoparietals and an interparietal, in turn preceding a pair of large parietal scales; three enlarged upper temporal scales adjoining posterior head scales; anterior temporal smallest, separated from sixth upper labial by a smaller, lower anterior temporal; second temporal large, followed by a third and smaller scale.

Nostril pierced between first labial and two nasals; anterior loreal higher than wide, widest at top, higher than posterior nasal, touching one labial; posterior loreal as wide as high, adjoining two labials; two

preocular scales (fused on one side), the upper long and very narrow, lower about as wide as high; upper labials seven (third and fourth fused on left side), fifth entering orbit, sixth the largest; four poorly-defined postoculars; scales in preauricular area more or less subequal in size, except those immediately bordering two large upper anterior temporals and labials; protuberant auricular lobules absent.

Mental large; three pairs of large infralabials, first pair forming a median suture, second pair separated on median line of chin by several scales slightly larger than remaining gular scales, third pair widely separated; a number of postlabials, first the largest; granules in gular region relatively large, about nine (near middle of throat) in vertical diameter of ear opening; a transverse gular fold.

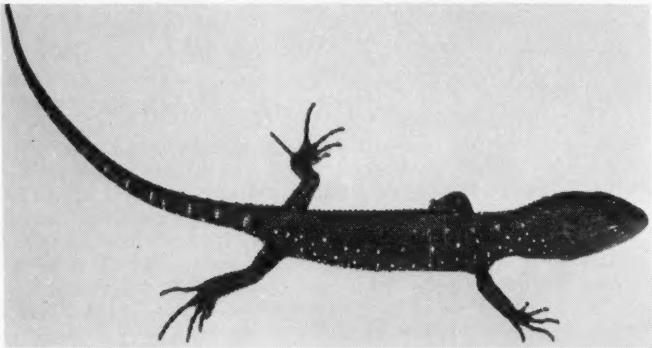

Plate 1. *Lepidophyma tuxtlae,* paratype, FAS 10548, from lower slopes of volcán San Martín, Veracruz, Mexico.

Neck, dorsal and lateral surfaces of body with variable conical tubercles; a middorsal band of ovoid, slightly convex granules, generally four scales wide, separating two single rows of somewhat elongate, trihedral tubercles, these scales bearing moderately curved surfaces; scales in each paravertebral row contiguous, nearly subequal; granules below, for a distance of four or five scale rows, similar to those of middorsal band, irregularly interspersed with a few larger tubercles; sides of body with enlarged trihedral tubercles in more or less parallel vertical rows, each tubercle normally separated from every adjacent one by a single row of small granules; a lateral fold, distinct at axilla, becoming less well defined near groin.

Venter with large, nearly square plates arranged in forty rows from gular fold to vent and in ten transverse rows at middle of abdomen; two outer rows distinctly keeled, most others with trace of keel on median posterior edge; ventrals near gular region becoming progressively smaller anteriorly and more nearly tubercular in form.

Scales on forearm ovoid and keeled, with little variation in size; those on underside of arm smaller and more tubercular; ovoid scales inside of thigh and lower leg; upper leg with slightly trihedral scales save those on posterior edge of femur which are strongly trihedral; remainder of leg with differentiated trihedral tubercles. Femoral pores 12-12; lamel-

lar formula of manus 6, 11, 16, 19, 10 (portion of third finger on left hand missing); of pes 7, 13, 26, 20, 18 (portion of second toe on right foot missing); a number of lamellae, particularly those at base of digits, divided at median line of digit.

Tail covered with whorls of heavily keeled scales; enlarged dorsal whorls near base of tail enclosing two rows of smaller scales and a feeble third row, this number increasing posteriorly so that near middle of tail three small and a feeble fourth row are contained between enlarged whorls; distal third of tail with four small rows between primary whorls; in each case, the small rows under the tail one less than the number dorsally.

Color in life black. A paravertebral series of white spots (8 pairs) from nape to insertion of hind legs; numerous small white spots laterally from temporal region to base of tail. Limbs with a few scattered light spots, more numerous ventrally. Top of head unmarked. A circular white spot on lower portion of each suture involving upper labials; sutures of lower labials prominently bordered by white; median suture of adjacent first lower labials white. Chin and throat black, speckled with white. Ventral plates white, many bearing dark pigment when viewed under lens. Tail black; enlarged whorls with short vertical bars of white, generally three or four scales long; these markings more numerous on underside of tail where they involve secondary whorls of scales as well, and where each white marking is only two or three scales long. A well-defined pair of white spots laterally at base of tail; another, less distinct pair, at insertion of forelegs.

Snout to vent, 51 mm.; tail, 63 mm.; head length (snout to posterior border of ear), 12.3 mm.; head width at widest point, 7.7 mm.; head depth, 5.3.; axilla to groin, 24.0 mm.; length of foreleg, 14.8.; length of hindleg, 19.4 mm.

Variation. In No. 10551, a juvenile, the median prefrontal is divided into two parts, anterior the smallest and approximately one-third size of the larger. Presumably this condition is anomalous. The prefrontal of No. 10552, also a juvenile, shows a similar division, and in addition, is bordered posteriorly by a small, narrow azygous scale. These juveniles are marked essentially like the adults; however, the white spot of the dorsum, the white bars on the tail and the white venter are lighter and more outstanding.

In the paratypic series, three specimens have seven gular scales contained in the vertical diameter of the ear openings; two specimens have six. The range of variation in snout to vent length is from 39 mm. to 82 mm., in tail length from 41 mm. to 90 mm., and in the axilla to groin measurement from 17 mm. to 40 mm. Individual femoral pore counts are: 11-11, 12-11, 12-12, 13-14, 14-13. Three specimens have 40 ventrals from gular fold to anus, two have 42.

Comparisons. This form is readily distinguished from other described *Lepidophyma* by the presence of contiguous and subequal tubercles in each paravertebral row. In the possession of black coloration it resembles the Costa Rican *reticulatum, anomalum* and *ophiophthalmum.* It further resembles *reticulatum* in having the second pair of infralabials separated by a few scales, and in having the first loreal higher than the posterior nasal. It differs in having only 14 femoral pores at the most; in the

possession of a median prefrontal and in having only 3 or 4 rows (instead of 5) of partial or complete scale annuli in each tail segment. From *anomalum* and *ophiophthalmum* it differs markedly in lack of contact of second infralabials, in tail annuli, in femoral pores, and from *ophiophthalmum* in the first loreal—posterior nasal sizes. From *microphalis* it may be distinguished by a fewer number of granules between paravertebral rows, fewer small caudal whorls between enlarged scale rows, by the presence of a median prefrontal and in the contact of only the first pair of infralabials. From *sylvatica* it differs in the presence of coarse tubercles along lower sides of the body, and in the presence of a median prefrontal. *L. tuxtlae* appears more closely related to certain members of the species *flavimaculatum* than to any of the above, and eventually it may prove to be a subspecies of that form. Primary differences between *tuxtlae* and the subspecies of *flavimaculatum* are to be found in coloration and in the nature of the paravertebral scale rows. From the subspecies *tehuanae, occulor* and *tenebrarum* it differs further in the presence of a median prefrontal; from *flavimaculatum* and *obscurum* in a lower femoral pore count.

HOUSTON ZOOLOGICAL GARDENS, HOUSTON, TEXAS and WICKENBURG, ARIZONA

A WESTERN HOGNOSE SNAKE EATS A COLLARED LIZARD.—A survey of the literature by Edgren (1955, Herpetologica, 11(2): 110-112) showed that the bulk of the food consumed by hognose snakes (genus *Heterodon* Latreille) is made up of amphibians, especially frogs and toads. Insects, snakes, lizards, small birds and mammals make up the remainder of the diet.

Only two records of *Heterodon* taking lizards as food are known to the writer. Anderson (1942, Bull. Chicago Acad. Sci., 6(11): 210) found that a captive eastern hognose snake (*H. platyrhinos* Latreille) took a fence lizard (*Sceloporus undulatus* Latreille). Breckenridge (1944, Amphibians and Reptiles of Minnesota: 113) stated that the stomach contents of a western hognose snake (*H. nasicus* Baird and Girard) included the remains of a prairie skink (*Eumeces septentrionalis* Baird).

On July 19, 1955, the writer captured a mature female *H. nasicus* on a dirt road about 6.2 miles southwest of Kismet, Seward County, Kansas. The snake was weak from lack of food (possibly toads) caused by the drouth. It was put into a canvas collecting sack along with a mature male collared lizard (*Crotaphytus collaris* Say) on the assumption that the two reptiles would not fight. About one half hour later, the sack was opened and the snake was observed chewing the body of the lizard between the limbs and the lizard held onto the snake. The snake then proceeded to work towards the head of the lizard, forcing it to release its hold. The snake began to swallow the lizard after it reached the head. The entire operation took about one hour in the collecting sack.

It is possible that the snake would not have taken the lizard had it been in a cage or in natural environment. It is also possible that the snake would not have accepted the lizard had its natural food been available.—*Richard A. Diener, Department of Zoology, University of Oklahoma, Norman.*

The Status of the Turtle *Macroclemys floridana* Hay

By WALTER AUFFENBERG

On the basis of four peripheral bones of the turtle *Macroclemys,* collected from a presumed Pleistocene deposit in Hillsborough County, Florida, Hay (1907) described a new species, *floridana.* More complete specimens from Pleistocene beds in Florida, and further examination of modern shells, suggests that the name *floridana* be placed in the synonymy of *M. temmincki,* the Recent species.

The additional fossil material includes two fine skulls and associated, but disarticulated post-cranial material (UF 9852, 1884). Almost all parts of the skeleton are represented in the collection. All were taken from, in, or below a consolidated freshwater marl near the bottom of Jug Springs, at a depth of about 40 feet, along the Itchtuckanee River, Columbia County, Florida (R16E, T6S, W½ Sec. 7).

Unlike vertebrate remains collected from the bed of the Itchtuckanee River and its tributaries (Simpson, 1929, 1930), which represent Recent admixture of Pleistocene material (Auffenberg, 1956), and which are black in color, the Jug Springs specimens are presumably much older and buff to brown in color.

Associated with the specimens of *Macroclemys* and imbedded in the same marl bed are remains of *Paramylodon* and *Parelephas* as well as those of many forms common to both Pleistocene and Post-Pleistocene faunal assemblages.

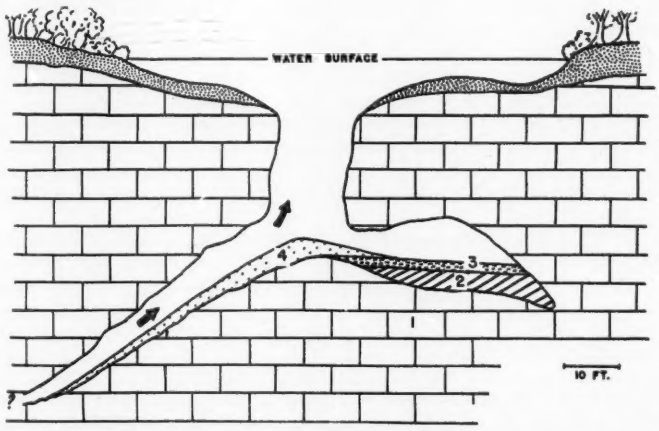

Fig. 1. A cross sectional view of Jug Springs, Columbia County, Florida. Bed. 1: Ocala Limestone; Eocene. Bed 2: A soft reddish-orange clay, containing remains of Pleistocene vertebrates, including *Macroclemys temmincki.* Bed. 3: A fresh water *Goniobasis* marl, containing the same fauna as bed 2. Bed 4: A bed which is Recent in age, covering most of the floor of the spring, and containing Pleistocene and modern faunal elements which are intimately mixed. Arrows show the direction of flow.

Freshwater springs in Florida frequently contain remains of extinct Pleistocene vertebrates, but the present locality is unusual for its stratigraphy and relative completeness of the contained animal remains.

Figure 1 illustrates a cross sectional view of the locality. The spring issues from the Ocala limestone, a well known aquifer of peninsular Florida, Eocene in age (Bed 1). In one of the large cavernous "rooms" of the spring a soft orange-red clay overlies the ocala limestone. It contains buff to brown mineralized remains of vertebrates including *Paramylodon* (Bed 2). Bed 3 is an indurated freshwater *Goniobasis* marl, containing complete remains of many turtles, alligators and occasional pieces of *Paramylodon* and *Parelephas.* Entire limbs, skulls and carapaces of turtles are quite frequently found in this stratum. As in Bed 2 they are buff to brown in color and frequently coated with an iron oxide compound, suggesting aereal conditions after deposition. Bed 1 is obviously Recent in age. It is largely composed of a stratum of loose *Goniobasis* shells. Included are remains of extinct Pleistocene vertebrates as *Parelephas,* as well as flint projectile points, steel gigs and lead fish line sinkers. Vertebrate remains from this stratum are either black or brown, the former evidently having washed in from the bed of the surface stream.

The large number of aquatic forms in Beds 2 and 3 point to depositional phenomena very similar and probably identical to those of today, i.e., a freshwater spring head. However, the extreme oxidation exhibited by certain elements suggests that after deposition the spring ceased flowing and was perhaps dry even at the bottom. Certain faunal elements lead to the same conclusion (Auffenberg, 1956). Rising and lowering water tables during the Pleistocene could easily account for these changes in rate of flow. Ancient dry springs have been reported in the area (Edwards, 1949).

The material on which Hay based his description of *Macroclemys floridana* included four peripheral bones. Of these he considered a fairly complete seventh element as the most diagnostic. The description and figures of this and the other bones given by Hay have been compared with the much more complete fossil material from Jug Springs and four modern skeletons of *M. temmincki* in the University of Florida collections (UF 3998).

Concerning the diagnostic features of the seventh peripheral of *floridana* Hay states that in *temmincki* this element ". . . differs from that of *M. floridana* in having a much more obtuse free border but especially in not having been in contact with the costal . . . On the upper face the ascending sulcus is not so near the anterior end of the bone . . . The costo-marginal sulcus on the anterior half of the bone is about halfway between the upper and lower border, but it suddenly descends to near the lower border." However, the latter is not evident from his figure.

Four fossil seventh peripherals are available from Jug Springs. The free border is quite variable in shape. The same is true of the peripherals examined in the modern skeletons. This variation includes that shown by Hay. The presence or absence of a fontanel is also variable. In the Recent specimens it varies from a direct contact, or no opening, to those in which the opening is approximately 25mm. at its greatest extent. It almost always varies within the length of the same costo-peripheral articulation, so that in one of the Recent specimens it varies from 3-8 mm.

along this articulation. The positions of the ascending and costo-marginal sulci are also quite variable (Fig. 2). This variation includes that given as diagnostic for *floridana.*

A fossil fourth peripheral was also available to Hay and was included in the description of *floridana.* The same element in *temmincki* differs, according to that author, from *floridana* in having ". . . the upper face much more convex and it rounds into the lower face so that the keel is hardly perceptible. The pit for the rib is nearer the hinder end of the bone and there is no excavation for the hyoplastron, the latter bone coming forward just to its hinder end."

Three fossil elements from Jug Springs show great variability in the convexity of the upper face and in the development of the keel. The pit for the reception of the rib is in the middle of the element in these specimens. In one of the Recent shells, the pit is near the posterior edge on the right side and is in the middle on the left. There is no excavation for the hyoplastron in any of the fossil elements from Jug Springs, but in one of the modern skeletons a small excavation is present. It is not, however, as large as that illustrated and described by Hay.

Hay assigned a bi-lobate posterior peripheral of a turtle to *Macroclemys floridana.* He considered this as representing the ninth right element. Although Hay's fourth and seventh peripheral elements obviously belong to *Macroclemys,* the posterior peripheral mentioned above is such an unusual shape for a chelydrid turtle that the assignment is highly questionable.

In size the element is dwarfed by any of the posterior elements of an adult *Macroclemys.* In both the latter and *Chelydra* the ninth, tenth, eleventh and twelfth peripherals are provided with only one process in both young and adult specimens. In the fossil element available to Hay two large processes are clearly shown and described. The costo-marginal sulcus is broadly obtuse, being almost parallel to the costo-peripheral articulation. In all of the specimens of *Macroclemys* examined during this study, both fossil and Recent, this sulcus is more acute, though admittedly variable.

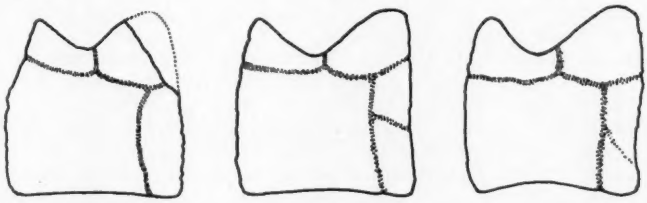

Fig. 2. The seventh peripheral element in specimens of *Macroclemys,* both fossil and Recent, showing the variability in sulci. A: Sulcus pattern exhibited in the type of *M. floridana* Hay and UF 9852, both from Pleistocene deposits in Florida. B. Sulcus pattern in another Pleistocene specimen (UF 9852) and a Recent shell (UF 3998). C. Sulcus pattern in UF 1884, a Pleistocene shell from Florida.

The size of the element, the sulcus and the two processes on the free border can be duplicated in any large posterior peripheral elements of *Pseudemys sculpta* or *P. scripta* (the former, considered an extinct form, is probably synonymous with the latter). These two species are almost characterized by the bi-lobate features of the posterior peripherals.

Almost all of the characters of the fossil elements of *Macroclemys* assigned to *floridana* by Hay can be duplicated in modern shells of *M. temmincki*. Quite complete Pleistocene specimens from Jug Springs cannot be reasonably separated from the modern species. Furthermore, in most characters they overlap widely the supposedly diagnostic characters of *floridana*.

Of particular interest is the fact that measurements and indices of the two almost complete skulls available from Jug Springs fall well within the range of *temmincki* as given by Zangerl (1945). This author reports a skull from the early Pliocene of South Dakota, which he assigns to the modern species. With the exclusion of *M. floridana* from the list of recognized fossil turtles the genus remains monospecific from the early Pliocene to the present. Presumably *M. schmidti* Zangerl, from the middle Miocene of Nebraska, is the direct ancestor of *temmincki*.

The genus *Macroclemys* obviously had a much greater distribution in the past than it does at present. Even *temmincki*, which at present is found in the larger rivers of the northern circumferential Gulf Coast area, occurred as far west as Nebraska during the Pliocene. In Florida the range of this species was greater during the Pleistocene than it is today. At present it occurs in rivers emptying into the Gulf of Mexico as far south as the Suwanee (Carr and Goin, 1955). Pleistocene records for the species extend the range considerably southward on the west coast of peninsular Florida, at least to Hillsborough County. These more southern rivers are, at least at present, fairly short and arise in relatively low-lying areas, many of them below the Pamlico Shore Line. Presumably seas during the Pleistocene completely inundated these stream courses, accounting for the absence of *Macroclemys* in them at the present time.

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A Functional Interpretation of the Integumentary Vessels of Snakes

By Fred N. White

Snakes are renowned for their remarkable evolutionary specializations, yet they represent a highly successful and widely distributed group of vertebrates. Loss of limbs and elongation of the body have been accompanied by numerous anatomical modifications such as staggering of visceral organs and development of an efficient serpentine locomotion. A striking feature of snakes is their ability to consume prey of considerable size. Facilitating this ability is a highly kinetic skull and a dilatable integument consisting of scales with expansible interspaces. Along with expansibility of the integument goes the problem of maintaining the cutaneous circulatory system in an uninjured condition. It is the purpose of this report to describe the arrangement of the integumentary vessels as well as to give a functional interpretation of this arrangement.

The circulatory system of snakes has been investigated by a number of workers. Among the most important of these are Hochstetter (1893), Beddard (1904, 1906), O'Donoghue (1912), Atwood (1918), and Ray (1934). There does not appear, however, to be a description of the integumentary vessels.

The integumentary vessels are derivatives of the intercostal arteries and veins. The integumentary arteries leave the musculature of the body wall at intervals of five to seven segments (*Thamnophis radix*) just ventrad of the muscular band representing the *M. retractor costae biceps*

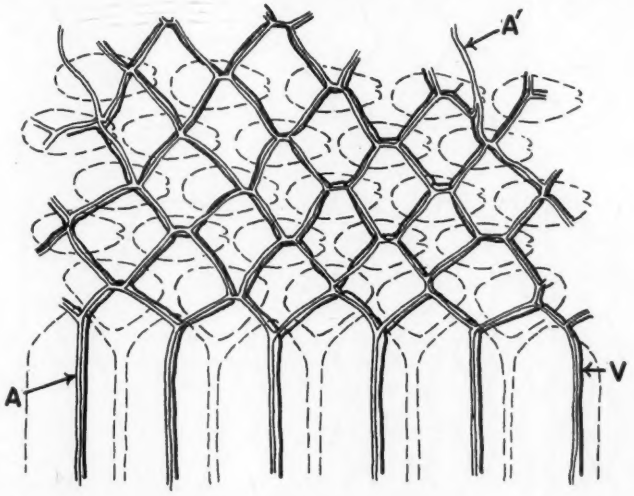

Fig. 1. General arrangement of the integumentary vessels. A—Integumentary artery, A'—Arterial derivative of Intercostal artery, V—Integumentary vein.

and immediately anterior to a *M. costocutaneous superior* (see Mosauer, 1935). The integumentary veins enter the body wall dorsad of the arteries between the *M. longissimus* and the *M. retractor costae biceps.* Each integumentary artery is preceded anteriorly (two to three segments) by an integumentary vein.

From their point of exit from the body wall, these integumentary vessels course directly to the subcutaneous connective tissue where they immediately become distributed over the internal surface of the skin in a particular arrangement. The vessels anastomose in such a manner as to form a definite meshwork of diamonds, more rarely hexagons, each of which adjoins its neighbors (Fig. 1). The pattern of distribution of these vessels is in definite relation to the scutellation. The points of union of adjacent diamonds or hexagons is approximately in the center of each dorsal scale (Fig. 1). The ventral scales are traversed medially by an artery and vein. Areas other than the trunk and neck exhibit vessels which are modified according to the scutellation. The subcaudal vessels are in two rows *(Thamnophis radix)* and in the neck region the meshwork is composed of elongate figures in conformity with the genials. Along the course of each vessel are small branches to the skin proper. In general, the distribution of veins and arteries is identical.

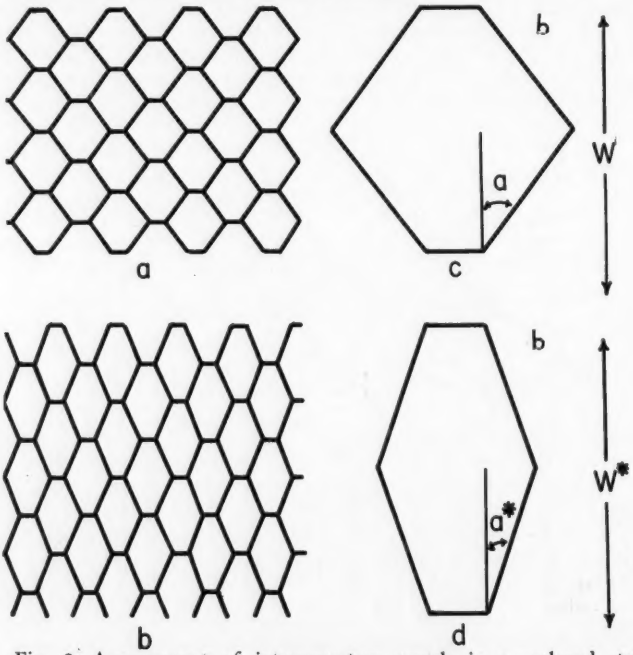

Fig. 2. Arrangement of integumentary vessels in a—relaxed state, b—stretched state; c, d—individual hexagonal integumentary figure. See text for explanation.

Constrictor constrictor and *Eunectes murina* have small, almost granular scales. In these forms the vessels are regularly present in the pattern described above, although the diamond configuration is compressed in conformity with the small size of the scales. *Dendraspis* is noted for its long and rather leaf-like scales. The integumentary vessels again conform in pattern with the scales. In a large number of genera examined, the uniformity in pattern of these vessels is constant.

The question naturally arises as to the functional significance of the vascular meshwork. It is well known that snakes have the ability to consume food of enormous size in relation to the diameter of the body. It is apparent to an observer watching the eating activities of a snake that the skin is placed under enormous stress as the scales may be stretched far apart. It is only reasonable to assume that the integumentary vessels are likewise subject to enormous stress during deglutition. The configuration of the vessels in the form of the hexagons or diamonds, however, seems to be the serpentine answer to this problem of stress. A piece of stretched skin exhibits the figures in a compressed and elongated form, as shown in Figure 2b, while relaxed skin shows the configuration shown in Figure 2a. It is highly doubtful that an arrangement of arborizing vessels could withstand such stress.

A plane surface can be completely covered by only a few polygons. These are either triangles, parallelograms or hexagons (Hilbert and Cohn-Vossen, 1952). Given such a meshwork of diamonds or hexagons arranged around the circumference of a body, the potential in increase circumferentially (without subjecting individual vascular segments to stretch) is surprisingly great. In Figure 2c and d, the angle a is decreased to a^* during circumferential expansion.

The length W may be determined: $W = 2b \cos a$. Considering the maximum of $\cos a^* = 1$, $W^* = 2b \cos a^*$; $W^* - W = 2b (\cos a^* - \cos a)$.

n = number of meshes in circumference

x = maximum increase in circumference: $x = 2bn (1 - \cos a)$. (1)

c = original circumference

$nW = 2bn \cos a = c$, $2bn = c/\cos a$, or $2bn = c \sec a$

Substitute (2) into (1), $x = c \sec a (1 - \cos a)$, or $x = c(\sec a - 1)$ (3)

For a *Thamnophis radix:* $a = 40°$, n = 19 (number of scale rows), b = 2 mm., c = 60 mm. x may be calculated as 18.3 mm. The percent increase in circumference is: 100 18.3/60 = 30.5%.

The above computation expresses the potential increase in circumference of the vascular network (without stretching the vessels) irrespective of the skin. This approach does not consider the elasticity inherent in the vessels, but considering that veins as well as arteries are involved, this figure is probably rather small. At any rate, the inherent elastic ability of the vessels would increase the above percentage by an undetermined amount.

The scales represent relatively inflexible areas of the integument as compared with the interscale areas. It is significant that the points of junction of adjacent diamonds lie near the center of scales. This allows

the long segments (b) to cover, primarily, interscale areas. Further, should a single scale lie over several meshes, the meshes could not deform. The existent arrangement is as efficient as could be imagined for the situation.

In several trials it has been possible to stretch circumferentially a 60 mm piece of skin of *Thamnophis radix* to 80 mm before tearing the skin. This probably represents greater than maximum expansibility for the skin in nature. However, if one takes this as maximal, there can be about 33.3 percent increase in circumference. The vessels may potentially increase circumferentially by about 30 percent irrespective (see above) of the skin.

It is apparent that an increase in circumference which does not apply stress to the vessels of the skin must be accompanied by the movement of scales horizontally toward one another. Observations on snakes feeding have shown that this need not be the case. The scales may actually move horizontally and vertically away from each other. Under such conditions the vessels *are* subjected to stress, within physiological limits. If, however, a very large object be forced through the alimentary tract of the animal, a point of expansibility is reached at which the scales do approach each other horizontally. It appears that the mechanism described above may come into play only after the physiological limit of expansibility of the vessels has been reached.

I wish to express my appreciation to Dr. Hobart M. Smith, University of Illinois Museum of Natural History, for his suggestions. I am indebted to Professor H. L. Langhaar, University of Illinois Department of Theoretical and Applied Mechanics, for his aid in presenting the mathematical interpretation.

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Melanism in Hog-nosed Snakes*

By Richard A. Edgren

Black specimens of the Eastern hog-nosed snake, *Heterodon platyrhinos* Latreille, have been recognized for over two hundred years. In 1743, in the second edition of his natural history of Carolina, Florida and the Bahama Islands, Mark Catesby figured and described melanistic hog-nosed snakes under the name *Vipera nigra.* Later workers, particularly Daudin, Harlan and Shaw (for complete synonymy see Edgren, 1952, and Schmidt, 1953), described black hog-nosed snakes with varying degrees of adequacy and under a variety of different names. Troost (1836) provided the first really comprehensive description and erected the combination *Heterodon niger* (Daudin), which was recognized by Baird and Girard (1853). Jan (1863) recognized the close affinity of *niger* and *platyrhinos* and applied a trinomial designation. Cope was apparently the first to realize that *niger* was only a color variant of *platyrhinos* as he did not even list *niger* in his 1875 check list. Since Cope, most workers have simply considered *niger* as a synonym of *platyrhinos,* although occasional studies list it as a subspecies or variety, generally with little consideration of the biology involved.

Typically, melanistic hog-nosed snakes are blue-black dorsally, often with a considerable suffusion of melanins on the ventral surface. Certain specimens, when examined minutely, show a trace of pattern on the posterior end of the body or on the tail, whereas others have a fairly general, but much obscured, pattern throughout all but the most anterior parts of the body. During the course of the present study some 879 specimens were examined which were well enough preserved to allow an accurate estimation of the presence or absence of the trait. Of these, 82, or 9.33%, were melanistic. Males (9.02%, 43 in 477) and females (9.72%, 39 in 402) show the trait in remarkably similar proportions, implying that there is no sexual dimorphism involved.

The trait is not distributed equally among differing populations of *platyrhinos.* Table 1 summarizes the distribution of the characteristic in the various states in which the species occurs. Certain states have a rather high proportion of melanistic individuals, whereas others have few or none. The significance of this mode of analysis of distribution is subject to question as melanism apparently occurs in high proportion in certain local populations and is lacking in others. Of 12 specimens from a presumably limited area in Indiana County, Pennsylvania, 6, or 50%, show either complete or partial melanism. A similar situation occurs in Grady County, Georgia; of 9 specimens from that area in the collection of the Chicago Academy of Sciences, 7 are melanistic (5 completely and 2 partially so). Two other populations are known that have a high percentage of melanistic individuals. Welter and Carr (1939) note that black specimens were taken almost as frequently as normally patterned snakes

*Extracted in part from a dissertation submitted to the graduate school of Northwestern University in partial fulfillment of the requirements for the degree Doctor of Philosophy. I am indebted to Professor Orlando Park who suggested and directed this problem.

in the vicinity of Morehead, Rowan County, Kentucky. The second such population has been called to my attention by Dr. Robert H. McCauley, Jr. Dr. McCauley noticed in his collecting in Clarendon County, South Carolina, that black hog-nosed snakes were more common than normally patterned individuals and began to keep records of the animals examined. Unfortunately, few specimens were collected after he began keeping records. Commenting on these he states (personal communication, September 18, 1951), "It seems to me notable that of 8 specimens seen in this area—only 2 or 25 percent have the so-called 'normal' markings."

In contradistinction to these four "populations" with a high proportion of black individuals, certain others show a complete lack of the trait. Over the past twenty years, all specimens seen from (and in) Muskegon County, Michigan were patterned. Similarly the trait seems lacking in Long Island, New York (31 specimens have been examined and Mr. M. Graham Netting of the Carnegie Museum informs me that he has never seen a melanistic specimen from there.)

Thus the geographic variability summarized in Table 1 may be the result of accidents in sampling the populations existing in the various states. It is possible that melanistic populations do exist in areas that have not been well collected. On the other hand one must admit that the wide divergences in proportion of melanism between such well collected states as Michigan, Florida, and Maryland (states with few melanistic individuals) and North Carolina, South Carolina, Pennsylvania, Illinois, and Indiana (states with a high proportion of black snakes) indicate geographic differences in the distribution of nigrescent individuals.

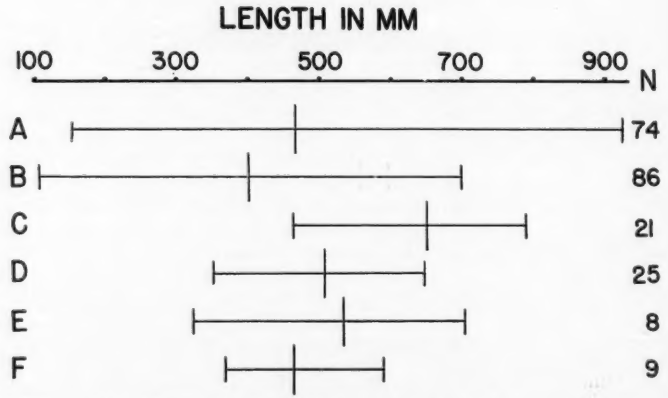

Figure 1. Means and ranges of total lengths for normally patterned (A, female; B, male), melanistic (C, female; D, male), and partially melanistic (E, female; F, male) specimens of the hog-nosed snake, *Heterodon platyrhinos*. N = number of specimens in each group.

In many organisms, the amount of dermal melanins deposited increases directly with humidity (Gloger's rule). This explanation seems untenable for *Heterodon* in view of the existence of mixed populations of black and patterned individuals. It would seem more logical to assume that this melanism is genetic in nature. Actually the entire problem of melanism in snakes needs further study. The Blanchards (1941) have studied the genetics of melanism in the common garter snake, *Thamnophis sirtalis sirtalis* (Linnaeus), and found it to act like a simple Mendelian recessive. Although the numbers involved were rather small, no other interpretation of their results seems possible. Melanism in *Heterodon* does not seem to be based upon any such simple situation.

Figure 1 shows the size relationships of the totally and partially melanistic individuals studied, as compared with the size range for normally patterned specimens. For each sex the partially melanistic individuals tend to be smaller than those that are entirely black, and all those that show traces of the character are average sized or larger. This would seem to indicate that genetically black individuals (assuming the character to be genetically controlled) show the normal patterned condition at birth, and become melanistic as they increase in size and age. As noted above the trait seems to be expressed first on the anterior portion of the body. Patterned young may develop into melanistic adults by the gradual deposition of melanins in the dermis beginning anteriorly and progressing posteriorly. Perhaps the expression of the trait is the result of certain physiological conditions, such as sexual maturity, the onset of which are correlated with age. Unfortunately, no broods are available from melanistic females; certainly breeding studies on black hog-nosed snakes are desirable.

Melanism in the Massasauga rattlesnake seems to be similar to this *Heterodon* pattern. According to Gloyd (1940, p. 54), black individuals are found scattered through Ohio, Illinois, Indiana, Wisconsin and Michigan and all are adults. Conant (1938) described a population, entirely of melanistic adults, from near Mt. Victory, Hardin County, Ohio. The young in this population were all spotted, and melanistic females gave birth to spotted young. Gloyd (1940, p. 54) states, ". . . I am inclined to think that this type of melanism is not explainable in terms of simple genetic inheritance, but that it is a change occurring late in the life of the individual and probably due to more complex factors." The inheritance of the trait, of course, may be of a rather simple type, but the expression may be the result of rather complex physiological conditions. Again, breeding studies should be undertaken.

In contrast to the *Heterodon-Sistrurus* type of melanism, which appears only in older individuals, is the type recently described for *Coluber* by Auffenberg (1955). In the racer, melanin deposition begins at hatching or even before. Darkening also appears to proceed cephalad from posterior regions of the snakes.

Although *Heterodon platyrhinos* ranges widely throughout the eastern United States it would seem to be edaphically restricted in its distribution to sandy areas where burrowing is possible (Edgren, 1952, 1956). Thus the structure of the species "population" is probably that of the widely ranging species broken down into smaller interbreeding units that Sewall Wright and many others consider optimal for evolutionary change.

The gene or genes for melanism are apparently being fixed in certain of these small populations. As hog-nosed snakes prefer sandy soils, which generally tend to be light in color, the melanistic individuals would be in sharp contrast to their normal substrates. Although little is known of the natural enemies of hog-nosed snakes, it seems probable that they are preyed upon by a variety of birds and mammals. These considerations

TABLE 1

Geographic distribution of melanism in *Heterodon platyrhinos*.

State	Totally melanistic	Partially melanistic	Patterned	Total	% Melanism
Alabama	2	1	14	17	17.6
Arkansas	2		8	10	20.0
Connecticut			7	7	0
Delaware			2	2	0
Florida	3	3	95	101	5.9
Georgia (Total)	7	2	14	23	39.1
Grady Co.	5	2	2	9	77.8
Illinois	7		51	58	12.1
Indiana	5	3	34	42	19.0
Iowa		1	14	15	6.7
Kansas			28	28	0
Kentucky	+		12	12	
Louisiana	3		36	39	7.7
Maryland	1	1	43	45	4.4
Massachusetts		1	16	17	5.9
Michigan	2		69	71	2.8
Minnesota			1	1	0
Missouri			14	14	0
Mississippi	1	1	24	26	7.7
Nebraska			1	1	0
New Hampshire			1	1	0
New Jersey	+		25	25	
New York (Total)	+		54	54	
Long Island			31	31	0
North Carolina	8		26	34	23.5
Ohio	+		6	6	
Oklahoma	1		6	7	14.3
Ontario	+		3	3	
Pennsylvania (Total)	5	6	25	36	30.6
Indiana Co.	3	3	6	12	50.0
South Carolina	3	3	25	31	19.4
Tennessee	3		10	13	23.1
Texas	+		21	21	
Virginia		1	31	32	3.1
West Virginia		1	26	27	3.7
Wisconsin			10	10	0

+ indicates a literature report of one or more melanistic individuals from the state.

suggest that melanistic individuals may be under strong negative selection pressures. The smaller maximum sizes of the black snakes may support this contention. This partial fixation in small populations of a trait that may be under strong negative selection pressures, suggests that the evolution of melanistic hog-nosed snakes may be an example of genetic drift or Sewall Wright effect.

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E. D. SEARLE & CO., P.O. BOX 5110, CHICAGO 80.

A BITE BY A SIDEWINDER RATTLESNAKE—On August 24, 1956, at 2:02 p.m., the author was bitten upon the tip of the middle finger of the left hand by a small adult (18 in.) specimen of the sidewinder rattlesnake (*Crotalus cerastes cercobombus* Savage and Cliff). The left fang penetrated to its full depth at a point just to the center right of the fingertip. The right fang made only a shallow penetration upon the extreme left side of the same fingertip. The bite occurred as the

snake was released. The fact that the snake had just been removed from an icebox in which it was being transported and, therefore, had a low body temperature would seem to indicate that less poison may have been introduced into the wound than would have been under normal conditions.

Immediately after the bite occurred a slight pain was felt. There was no burning sensation as has so often been described in accounts of bites by poisonous reptiles. Within a minute a tourniquet had been tied about the wrist. A light spray of ethyl chloride from a Gebauer dispenser was directed over the upper half of the finger which had been covered with a single thickness of tissue paper to avoid freezing the tissue. Cross cuts were then made over each puncture mark. At 2:10 there was still very little swelling at the site of the bite and only slight pain. There was also a slight tingling sensation at the base of the finger. By 2:20 the tip of the finger was swollen considerably, and by 2:35 the surface over and immediately surrounding the bite area had become a characteristic bluish black.

At approximately 2:40 the writer arrived at the Anaconda Bluewater Clinic in Grants, New Mexico. Here his hand was placed in cold water from the tap. No ice was used. At this time the swelling had progressed to the base of the finger. By 2:45 the back of the hand was beginning to swell and an itching sensation was felt at the base of the finger. There was still very little pain. A spot test was then given for possible allergy to horse serum. At 3:02, just one hour after the bite occurred, 15 cc. of Nearctic Crotalidae Antivenin were given locally, regionally, and systemically. Pain, dizziness and slight nausea accompanied the shots. By this time the swelling had progressed throughout the back of the hand and wrist.

At 3:30 pain was felt which had not been present since the time of the shot and the finger had become discolored. By 4:00 the pain had spread throughout the left arm, accompanied by a slight swelling and stiffness at the joints. Ten minutes later the armpit, wrist and hand began to throb. At about 4:45 the patient experienced nausea and slight chills which were probably caused in part by the pain in the hand and wrist. An hour later the fingers of the left hand could barely be moved; it was painful to move any of the joints in the left hand and arm; slight pain was felt in the left side of the chest when inhaling.

At 9:00 p.m. the patient was admitted to Bataan Hospital in Albuquerque, New Mexico, for observation. By this time the pain had decreased slightly. At 10:30 2 cc. of penicillin were injected in order to prevent infection and possible gas gangrene. At 10:45 a two quart solution of 5% dextrose was started intravenously.

At 8:30 a.m. the following morning another 2 cc. of penicillin was given. At this time some pain and swelling were still present in the hand and wrist, but absent in the arm. Some pain was experienced when moving the wrist but not any at the elbow or armpit. The patient was released from the hospital at about 2:30 p.m. The area of the bite remained tender for three days after which time the swelling in the wrist and hand, which had gradually been decreasing, was completely gone. The site of the bite remained swollen for about three weeks.—*James A. Lowell, Columbia University, New York, New York.*

RANA VIRGATIPES IN SOUTHERN MARYLAND, WITH NOTES UPON ITS RANGE FROM NEW JERSEY TO GEORGIA*—*Rana virgatipes* Cope (1891), the carpenter frog, was first recorded in 1940 by Roger Conant in Delmarva from the Great Cedar Swamp, south of Millsboro in Sussex County, Delaware. Later, in 1945, Conant remarked that "the extensive drainage operations now in progress may well have destroyed this habitat," with the additional note that this frog had been collected there as late as the spring of 1942. To my knowledge no later collections have been recorded or published from Sussex County.

In 1947, Conant recorded the carpenter frog from Dorchester County, Maryland, this being the first record from this state. No further collections of this frog have been recorded from either Delaware or Maryland.

While collecting in southern Maryland, in Charles County, the author collected a specimen in a low wet woods near Mason Springs. The identification has been verified by Dr. Doris M. Cochran. This is the first record for *virgatipes* in Maryland west of Chesapeake Bay.

These three localities lie on the Coastal Plain, the Sussex County and Dorchester County specimens being found on the Outer Coastal Plain, and the Charles County specimen on the Inner Coastal Plain. All these areas are or have been wet swampy woods, where there are fallen trees and much organic debris. Tall grasses, sedges and cat-tails along with *Smilax* make the swamp impenetrable in places. Localities similar to these have been recorded for the habitats of this frog from New Jersey to Georgia along the Inner or Upper Coastal Plain as well as for the Lower Coastal Plain.

All specimens of *virgatipes* in the United States National Museum have been seen and studied. Most of the specimens are from New Jersey, with which the present Charles County specimen compares favorably. Neill (1952) made an extensive study of the specimens of *virgatipes* and *Rana grylio* from South Carolina and Georgia. He called attention to the fact that *virgatipes* is found on the Upper Coastal Plain. However, Schmidt (1953) gave the range as the Lower Atlantic Coastal Plain, from southern New Jersey to southeastern Georgia.

The Coastal Plain from New Jersey to Georgia is divided into two areas: the Inner or Upper Coastal Plain, which is nearer the Fall Line, in turn an arbitrary demarcation between the Piedmont and the Coastal Plain, and the Outer Coastal Plain. Schmidt has confined the distribution of *virgatipes* to the Lower Atlantic Coastal Plain. This does not seem justified, for while plotting the distribution of this species from New Jersey to Georgia, the author became aware that there were about as many specimens from the Inner or Upper Coastal Plain as from the Lower Coastal Plain.

Rana virgatipes is known from the Upper or Inner Coastal Plain in New Jersey (Mercer, Burlington, Monmouth and Essex Counties), Maryland (Charles County), North Carolina (Cumberland and Moore Counties), South Carolina (Allendale and Lexington Counties) and Georgia (Screven, Jenkins and Richmond Counties). The areas in South Carolina and Georgia are along the Savannah River and not very far

*Contributions to the Herpetology of Maryland and Delmarva, No. 16.

from each other. This species is known from the Outer or Lower Coastal Plain in New Jersey (Atlantic, Cape May, Burlington and Ocean Counties), Delaware (Sussex County), Maryland (Dorchester County), Virginia (Norfolk County), North Carolina (Beaufort, Craven, Washington and New Hanover Counties) and Georgia (Carlton County and Okefinokee Swamp Area). The distribution of *virgatipes* should read: Coastal Plain from New Jersey through Delaware and Maryland to Virginia, the Carolinas and southeastern Georgia.

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—Clyde F. Reed, 10105 Harford Rd., Baltimore 34, Md.

SOME HERPETOLOGICAL RECORDS FROM CENTRAL PENNSYLVANIA.—The author has known for several years of important records of reptiles and amphibians in Pennsylvania. With the advent of the Pennsylvania Herpetological Survey, centered at the Carnegie Museum, Pittsburgh, it seems advisable to publish these now. It is regrettable that specific dates are not available for several of these.

Pseudacris triseriata feriarum (Baird). On March 31, 1951, Mr. Harry Bodley, formerly laboratory technician at Devitt's Camp (now Devitt Home), Allenwood, collected a series of eight specimens two miles west of Allenwood on Route 957, Gregg Township, Union Co. The locality is at the foot of the Devitt Home road. Mr. Bodley now resides in Somerdale, New Jersey. Eight males collected by the author at Elimsport, Lycoming Co., April 20, 1957 have tibia/body length ratios from .48 to .52 comprise the first record from this county.

The tibia/body length ratios in Mr. Bodley's series are lower than those of the two Pennsylvania populations reported by Smith and Smith (1952, Amer. Midl. Nat., 48:165-180) varying in four females from .451 to .482 (av. .469), and in four males from .421 to .481 (av. .463).

The ratios in two populations recorded by Smith and Smith (*op. cit.*) from Berks and Huntingdon counties were, respectively, .51 and .50. For the thirty-six specimens examined by them from Huntingdon Co., the extremes were 46-54%. Two specimens of the Allenwood series, the largest female, and the smallest male, have lower percentages than these extremes.

These differences may in part be due to differences in mode of preservation. Nevertheless proportions are important in this frog, and further studies should be made to determine the geographic variation. Nomenclature after Schwartz (1957, Amer. Mus. Nov.)

Cryptobranchus a. alleganiensis (Daudin). In September, 1949, Raleigh Hodil, son of Dr. and Mrs. Elmer Hodil, formerly of Devitt's Camp, Allenwood, caught a large adult male hellbender while fishing in Spring Creek, about one mile west of Allenwood, Union Co., near the home of Harold Bailey. The live specimen was seen by the author the day after it was caught, and was of a distinct reddish-brown hue dorsally, with scattered blackish blotches. The edges of the vent were distinctly swollen. This adds Spring Creek to the known inhabited drainage in Union Co. It has previously been reported from Penn's Creek, Buffalo Creek, and the Susquehanna River in Union Co. (Pawling 1939, Herpetologica, 1: 165-169).

Carphophis a. amoenus (Say). One specimen was brought to the author by boy scouts, and was collected at Camp Karoondinha, three miles west of Glen Iron, Union Co. The specimen escaped before it could be preserved. This is the first report from Union Co.

Graptemys geographica (Le Sueur). In August, 1948, a large female map turtle was captured in the west branch of the Susquehanna River approximately 3 mi. NW Northumberland (measured along the river), Northumberland Co., by the author and Eugene Conrad of Northumberland.

Here, as in other localities along the flood plain of the west branch of the Susquehanna River in Northumberland County, the soil is quite sandy and presumably ideal for the laying of turtle eggs.

The turtle had nothing in its stomach. The following measurements were taken before dissection: carapace length, 190 mm. (taken to the greatest extremities); carapace width at widest point, 146 mm.; plastron length, 169 mm.; length of bridge, 62 mm. (on both sides); head width 36 mm.; total tail length from body to tip, 56 mm.

In the lower Susquehanna River drainage, *Graptemys geographica* is present in Pennsylvania in Lancaster, Dauphin, Perry, Huntingdon, and Bedford counties. This is the first record from Northumberland Co., and, to the author's knowledge, the farthest up the Susquehanna River in Pennsylvania that it has been reported.

The series of *Pseudacris* and the *Graptemys* have been deposited in the Carnegie Museum. The author is indebted to Mr. Neil D. Richmond of that institution for advice on the distribution of these forms in Pennsylvania.—*Edwin L. Bell, Albright College, Reading, Pennsylvania.*

AN APPARATUS FOR REARING SMALL FROGS—A pronounced abnormality of the tail (scoliosis) was noted recently in a group of tadpoles of *Rana sylvatica* Le Conte. Its frequency and its resemblance to an inherited condition in fishes suggested a genetic basis, and a number of both normal and deformed individuals are being reared with breeding experiments in mind.

Several arrangements of aquaria, covered finger bowls, and other

glassware were tried in maintaining the newly metamorphosed frogs, all with some degree of inconvenience. At the present time, an adaptation of a type of plastic freezer and refrigerator box is being used. It has proven so satisfactory and has so simplified the care of these small frogs that its description may be worthwhile to anyone working with groups of small amphibians. Salamanders have also been kept successfully under the same conditions. The major requirement is a sink, water table, or other drain for running water.

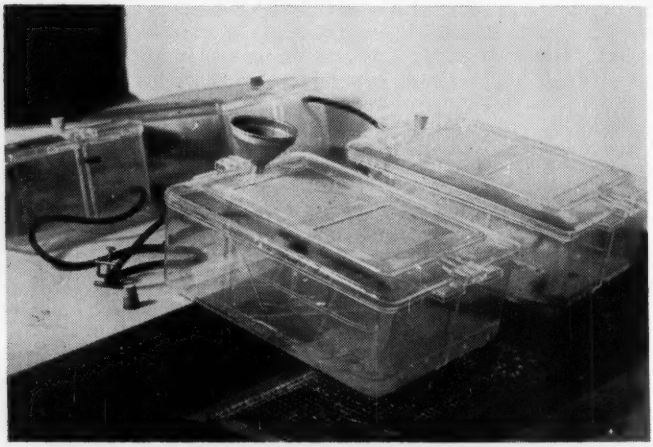


Fig. 1. Rearing boxes in use.

The box is one of several sizes manufactured by the Tri-State Plastic Molding Company of Henderson, Kentucky. It is made of transparent Styron plastic and can be easily carved, sawed, and drilled with simple hand tools. As now in use (Fig. 1) the boxes are slightly tilted, with a continuous flow of water entering via a tube near one corner of the higher end and draining through a series of small holes at the lower end. A reservoir of water is maintained at the level of these holes, even if the water supply should fail. Circulation in this reservoir is improved by having the lowermost hole diagonally opposite the inlet stream. One side of the box remains dry. Adequate ventilation is provided by cutting out the central part of the lid and cementing a thin cloth in its place. The lid fits tightly enough to retain even *Drosophila.*

A hole in the lid, corked when not in use, receives a small funnel for feeding and flushing. Tubifex, chilled house flies, etc., can be dropped into the box in this manner. Vestigial-winged *Drosophila* can be shaken directly from the culture bottle into the funnel. A brief daily flushing by way of the funnel suffices to keep the box reasonably clean. About once a month the frogs are removed and the box is washed. This monthly cleaning is ordinarily the only time the box need be opened or the frogs handled.—*James C. List, Dept. Biology, Loyola Univ., Chicago.*

The Desert Tortoise in Captivity

By UNA G. NICHOLS

Three *Gopherus agassizi* have been in my possession for more than twenty-six years. The first was a male from a desert wash near Red Rock Canyon, California, October 11, 1929. Since his shell was only 2½ inches wide by 2 7/8 inches in length, he must have been very young. We found two more of approximately the same age, three or four miles from Randsburg, Kern County, California, May 17, 1930. Several years later two adults were added to the group.

One or more of the females have been laying eggs since 1945, but it was not until 1952 that the first hatchling appeared. To my knowledge ninety-eight eggs have been dropped into nestholes and covered with slow, methodical care, but only eleven hatched. The attached table gives the dates when the eggs were laid and hatched, also the years in which each female mated. I broke open more than two thirds of the eggs that did not hatch and found them infertile. One laid four eggs in their house one cold day in late spring. However, I kept these eggs in a place unsuitable for hatching.

When hatchlings settle down among dun-colored stones or on the ground, half hidden from sight among a few weeds, they are almost invisible. They often hide in small crevices, while resting. Consequently, three which hatched at an uncertain date may have been overlooked by me for several days, even though I searched the tortoise yard daily for some time before and after a nest of eggs was expected to hatch. The fence surrounding their yard is so constructed as to make it impossible for even a hatchling to escape.

The tortoises prefer the northeast corner of their yard for a nesting-site. The soil had been mixed with sand several years previously and the females find it easier to dig nestholes there. Dry and sunny, this is also the most suitable spot for incubation. The northwest corner of their yard is dry in summer and almost covered with large flat rocks. The tortoises spend many early morning and late afternoon hours sunning themselves on the warm rocks. They drink from a shallow metate and feed on the grass, clover and other plants that cover the south half of their yard. Since their low building is wind and rain proof, it serves as a burrow in summer and den in winter. An attempt has been made to duplicate conditions in their natural habitat. Since the number of eggs that hatched compared to the number laid is small, it would be interesting to know whether the same or a greater degree of fertility is achieved in the wild.

Female No. 3 has been known to lay eggs only once. Several days prior to this she spent the latter part of the afternoon and early evening digging nestholes — not an easy task for a cripple. Her right hind foot had been severed at the second joint before she left her desert home. As a consequence the leg is so short that her shell dips until the plastron near it taps the ground at each step.

With her left hind foot she scooped a hole in the earth, then, just as vigorously and instinctively, scratched the surface with the right in ignorance that the stump was an ineffective tool. When completed the first and third holes were broad and shallow on one side and almost the usual depth and shape on the other. However, when the second was half finished she wandered off for a short time. Turning around, she worked from the opposite side. The result was a more symmetrical hole than the others, although far from perfect. This was the one in which she later deposited the only eggs she has been known to lay. The fact that none hatched was not surprising since to my knowledge the male has never shown the slightest interest in this cripple. As a rule his courtship is both prolonged and deliberate, for this reason it is doubtful whether he has ever mated with her.

Each spring the male has chosen a female and with one exception been attentive to none other during that season. Also he has seldom if ever been known to have the same mate for two successive years until recently.

TABLE

Eggs	Laid		Hatched		Year Mated
		TORTOISE NO. 1			
3	June 16	1947	0		1946
4	May 23	1948	0		1950
9	July 28	1950	0		1952
6	July 6	1952	1	October 17	1955
7	June 9	1953	0		
5	June 24	1954	3	October 5	
4	May 17	1955	0		
		TORTOISE NO. 2			
4	May 23	1949	0		1945
6	June 9	1950	0		1948
2	March 28	1951	0		1953
9	May 29	1954	2	Sept. 9 to 20	1954
5	June 12	1955	0		
4	July 1	1956	0		1956
		TORTOISE NO. 3			
5	June 22	1955	0		
		TORTOISE NO. 4			
4	June 17	1945	0		1944
3	May 21	1946	0		1947
5	May 30	1949	0		1949
2	June 3	1950	0		
6	June 26	1953	4	Oct. 7	1951
4	June 24	1954	0		1954
3	June 8	1955	0		1955

During the second week of July, 1955, female No. 4 began to follow the male wherever he went. Occasionally hastening forward and facing him, she bobbed her head rapidly for several minutes at a time and even struck him with her gular horn. Even though she has been his choice more often than the others, he continued to ignore her as the weeks passed. It was not until the middle of September that she succeeded. For the first time in the history of this group, female No. 4 not only took the initiative in courting. but succeeded in luring the male from the tortoise of his choice for the rest of the season and continued to be his mate during the following summer.

The shell of female No. 4 had been crushed in an accident just prior to her joining the group in 1943. At the end of two years a thin protective layer of skin had spread out from beneath the damaged scutes until it met, covering the flesh. This skin gradually changed until it was similar to the horny, tuberculous skin of the reptile's forefeet. During the last few years it has thickened and hardened even more and now resembles the shell. The broken scutes project over this new growth, forming a slight hollow.

The scutes of a hatchling are thin, the bones comparatively undeveloped and weak. The shell of the first hatchling was still frail at the beginning of the following summer. One warm summer morning I put him in the adult's yard. With the alert manner of the desert tortoise when his curiosity is aroused, the adults, gathering round, stared at him and nudged his carapace with their snouts. The young tortoise withdrew his head and feet into his shell. A moment later, darting between them, he scuttled to a far corner.

While the small tortoise was sunning himself the following day, female No. 1 drew near. Instead of walking over him as one tortoise often does when it comes face to face with another that is traveling in the opposite direction or resting, she sank to the ground when she was above him. The earth was very soft and so he was not injured. Less than a week later female No. 2 stood over the small tortoise and appeared to deliberately lower herself. I had to lift her before the hatchling could be rescued. Three days later he died. When first I saw the young tortoise that hatched between October 5th and 9th, 1954, he was on the far side of the yard with female No. 1 hastening toward him. Before I could reach them, the hatchling was crushed in the same way as the first. One fourth of the shell was flattened. He died within a few minutes.

None of the young tortoises hibernated during the first winter of their lives, but all have done so since then. The first became inactive November 11,1954, another followed on the twelfth, a third on the thirteenth and a fourth on the fourteenth.

The middle of the following February was warm; on the twenty-third the temperature rose to 84°. The young permanently left their winter quarters for the season that day.

October 20, 1955, the young began to hibernate. By November 4th, all had retired for the winter.

Three left their quarters March 4, 1956, four on March 7th and one March 9th. However, the first of April was cold with a temperature of 47°. The young were torpid for several days although the adults were

as active as usual, even staying out one afternoon for nearly an hour after a cold rain began to fall.

The habitat of these tortoises in the wild is comparatively dry. The only water available to some is that which drains into hollows and depressions in the rocks during the short seasonal rains. These tiny pools usually disappear within a short time through evaporation and percolation into the soil. Most of the year the food of these tortoises is comparatively free from moisture also, as it consists of dried plants and grasses.

My adult tortoises have had an adequate supply of water always. They feed on rose petals, sliced fruits, lush grass and clover. However, I decided to withhold water from all but the first hatchling in order to see what effect, if any, the lack of it would have on them.

The young reptiles' enclosure was in a corner of the yard on which the sun shone all day. However, a small shed at one end provided shelter from the direct rays of the sun during hot weather, and a place in which to spend the night. The ground was composed of dry, sandy soil.

From the time of hatching, the young have shown good growth and been active. When three of the tortoises were three years of age and five were two, they were given water for the first time. Although it was an unusually hot day, two reptiles drank four swallows of water, one took three, three more had two, and two merely touched the liquid with their snouts and turned away. This was quite different from the response of the first hatchling, as well as three of the older tortoises at approximately the same age. They had been provided with water from the first and usually took at least twelve swallows, often without pause, and frequently as many as sixteen before turning away.

After an adult has had a drink of water, occasionally it urinates in its house. From that time, two or more of the animals, especially the male, will not sleep inside unless forced to do so, until the building has been thoroughly hosed and aired. It may be that these tortoises move to another burrow under similar circumstances in the wild.

3405 THIRTY-THIRD STREET
SAN DIEGO, CALIFORNIA

Notes on Mexican Amphibians, with Description of a New *Microbatrachylus*

By William B. Davis and James R. Dixon

During June and July, 1956, the junior author and his wife Mary collected several hundred amphibians incidental to a field study of the Mexican toads of the genus *Tomodactylus*. Several of them are of special interest and are here reported. All specimens are deposited in the Texas Cooperative Wildlife Collection. Texas A. and M. College.

Scaphiopus couchi Baird. *Tamaulipas:* 10 mi. S Mante, 1. *Sinaloa:* 20 mi. N Mazatlán, 150 ft., 3; Concordia, 400 ft., 1. *Sonora:* 13 mi. S Masiaca, 300 ft., 6.

Although toads from Sinaloa and Sonora are more heavily pigmented (fewer large cream colored blotches) than specimens from southern Texas, we cannot detect in our specimens the differences of greater size of eye, greater width of skull, and width of the "shovel" Taylor (1936, Univ. Kans. Sci. Bull., 24:505-537) observed in his specimens from Sinaloa. It is possible these west Mexican toads are subspecifically distinct from *couchi,* in which case the name *rectifrenis* may apply (see Smith and Sanders, Texas Jour. Sci. 1952: 209). We have followed the conservative course suggested by Zweifel (1956, Amer. Mus. Nov., 1762:35).

Scaphiopus hammondi multiplicatus Cope. México: 3 mi. E Texcoco, 7500 ft., 3. *Oaxaca:* Nochixtlán, 6900 ft., 2. *Michoacán:* 6 mi E Quiroga, 7800 ft., 1; 3½ mi. W Zacapu, 7100 ft., 1. *Jalisco:* 5 mi. S Santa Cruz, 5200 ft., 1.

The two specimens from Oaxaca are juveniles and are from near the southern limit of the known range (Zweifel 1956:32). Dixon saw several other specimens in the pine forest just north of Oaxaca City and some 30 miles southeast of Nochixtlán. He did not find them south of this locality.

Bufo alvarius Girard. *Sinaloa:* 24 mi. N Los Mochis, 50 ft., 1; 35-45 mi. N Los Mochis, 100 ft., 2. *Sonora:* 13 mi. S Masiaca, 300 ft., 1; 6 mi. N Navojoa, 300 ft., 1.

The Dixons observed many of these large toads on the highway between Los Mochis and Navojoa, many of them so large they were not picked up because of lack of suitable storage space. Seemingly this toad has not been reported previously from Sinaloa.

Bufo debilis kelloggi Taylor. *Sinaloa:* 4-33 mi. SE Escuinapa, 50 ft., 3; 24 mi. N Los Mochis, 50 ft., 43. *Sonora:* 13 mi. S Masiaca, 300 ft., 3; 8 mi. S Navojoa, 300 ft., 1.

The status of *kelloggi* is still in dispute. Taylor named it a full species. Sanders and Smith (1951, Field & Lab., 19: 141-160) considered it a subspecies of *Bufo debilis.* Savage (1954, Texas Journ. Sci., 1954: 112) presents evidence to support Taylor's view, but the latest study (Riemer, 1955, Herpetologica 11: 17-23) supports the conclusion of Sanders and Smith, which we follow. The last two authors conjectured a range for *kelloggi* including southern Sonora. This has now been confirmed by our records.

Eleutherodactylus augusti Dugés. *Hidalgo:* Puerto de la Zorra, 6 mi. NE Jacala, 5300 - 6000 ft., 2. These specimens, both males, were found inside large limestone boulders in which numerous small water-worn galleries offered retreats from which the frogs were calling. The rocks had to be broken open with hammers in order to get the frogs. Seemingly these are the first records of *augusti* from Hidalgo.

Syrrhophus modestus Taylor. *Nayarit:* 30 mi. SE Tepic, 3000 ft., 2. These two specimens appear to represent the first reported record of *Syrrhophus* from Nayarit. They agree in most respects with Taylor's description and measurements of *modestus* from Colima. They were found during a rain at night in low bushes where they were calling.

Microbatrachylus fuscatus, sp. nov.

Holotype. TCWC No. 12171, female, from 20 miles east of Tulancingo, 7300 ft., Hidalgo, Mexico; collected May 31, 1956, by James R. and Mary Dixon, original no. 4027.

Paratype. TCWC No. 12172, young female from the same locality, same date and collector.

Diagnosis. A Small Microbatrachylus in the *oaxacea-lineatissimus* complex with three palmar tubercles; tibiotarsal articulation to tip of snout or beyond; no vomerine teeth; with hind legs folded at right angles the heels overlap; choanae not concealed under overhanging jaw when viewed from below; dorsum rusty brown in life, blackish brown in alcohol; diameter of tympanum about 60 per cent that of eye; a continuous mid-dorsal ridge flanked on each side by three discontinuous, irregular glandular ridges arising from eyelid, the middle one the least distinct.

Comparisons. Appears to be most closely allied to *M. oaxacae* Taylor, but differs chiefly in (1) shorter hind leg (29.8 mm. as opposed to 35.2 mm.); (2) outer palmar tubercle small (not large); (3) dorsal color in life rusty brown, not pinkish or rose color, etc. Differs from *lineatissimus* which has three palmar tubercles in (1) absence rather than presence of vomerine teeth; (2) choanae not concealed, rather than partly concealed by overhanging jaw when viewed from below; (3) tibiotarsal articulation reaching to tip of snout or slightly beyond, rather than much beyond tip, etc. Resembles *M. lineatissimus* Taylor in the presence of seven dorsal and dorsolateral glandular folds or ridges, counting the continuous mid-dorsal ridge and three discontinuous dorsolateral ridges on each side. Differs from *M. montanus* Taylor in (1) much smaller size (S-V length 17.5 mm. as opposed to 27 mm.); (2) paratoid gland present rather than absent, etc.

Measurements of holotype (in millimeters). Snout-vent length, 17.5; arm, 10; hind leg, 29.8; foot, 14.4; tibia, 10; tympanum, 1.5; eye, 2.4; eye to nostril, 1.8; eye to tip of snout, 3.0; eyelid, 1.3; interorbital width, 2.2; width between nostrils 2.2; width of head, 7.0.

Color (in alcohol). Upper parts blackish brown, inguinal area whitish; side of head like back; upper lip with faint whitish spots; underparts much lighter; chest and throat moderately flecked with dark pigment, paling toward thighs; underside of thigh and inner side of shank whitish, faintly peppered with dark flecks; upper side of thigh and shank pale brownish crossed by three darker transverse bands; distinct

triangular dark spot in anal region, with apex joining dark dorsal coloration.

Remarks. The specimens were found by Mary Dixon in grass and leaves at the edge of a seep below a dam that impounded water in a large reservoir south of the highway and about 10 miles southwest of Huauchinango, Puebla.

Agalychnis dacnicolor (Cope). *Jalisco:* 10 mi. SE Las Animas, 3000 ft., 5. *Nayarit:* 23 mi. NW Tepic, 500 ft., 1. *Sinaloa:* 14 mi. SE Escuinapa, 100 ft., 1; 2 mi. E Mazatlán, 50 ft., 1.

Banana frogs were common at most of the lowland localities visited by the Dixons in western Mexico. They were especially abundant on the highways following heavy rains. Many were mutilated by autos and few were alive or in condition to preserve. The record for Jalisco seems to be the first for that state (see Smith and Taylor, 1948, Bull.-U.S. Nat. Mus., 194).

Pternohyla fodiens Boulenger. *Jalisco:* 5 mi. S Santa Cruz, 5200 ft., 10; 10 mi. NW Tequila, 3800 ft., 2. *Nayarit:* Ahuacatlán, 3300 ft., 2. *Sinaloa:* Concordia, 400 ft., 1. *Sonora:* 13 mi. S Masiaca, 300 ft., 5.

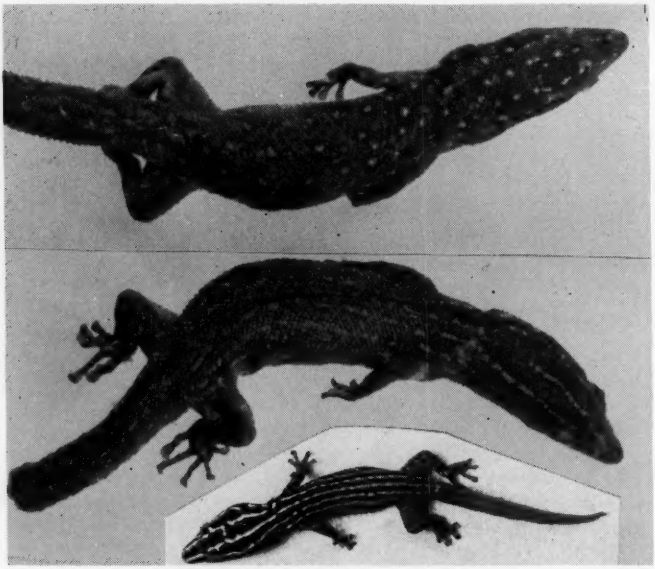
The Dixons arrived in western Mexico at the onset of the rainy season and *Pternohyla* were abundant at several of the above-listed localities. They were all found on the ground in open fields or near rainpools. Their experience with this species is at variance with that of E. H. Taylor (1936, *op. cit.*) because they found the frogs to be unwary and easily captured. We have found that many frogs which are unwary at the onset of the rainy season when the urge to breed is dominant become wary and exceedingly difficult to capture later in the season. Perhaps *Pternohyla* has a similar behavior pattern.

Our specimens from southern Sonora seem to be the first records from that state.

DEPARTMENT OF WILDLIFE MANAGEMENT,
TEXAS A. AND M. COLLEGE, COLLEGE STATION, TEXAS

THE LOST SPHAERODACTYL (REPTILIA: *LACERTILLA*) OF CUBA.—The first record of *Sphaerodactylus argus* Gosse in Cuba was published in 1880 by Gundlach (Erp. Cubana: 59) who stated: "*Sphaeriodactylus* [sic] *argus* Gosse, Salamanquita. Esta es una especie rara, pues he cogido solamente 2 ejemplares y estas en Santiago de Cuba. El tipo es de Jamaica." (This is a rare species since I have taken only 2 examples from Santiago de Cuba. Type locality is Jamaica.)

Barbour's initial verdict (1914, Mem. Mus. Comp. Zool., 44:263) on this record was as follows: "*S. argus* . . . what Gundlach . . . called this species, was undoubtedly a peculiar phase of coloration of the young *S. cinereus*. A specimen of this species which I collected near Cienfuegos, and several from Jiguari appear as far as their general type of color pattern is concerned, to be typical *S. argus*. This, however, they certainly are not."



Upper: spotted form of *S. argus* found in eastern Jamaica and in Cuba. Center and lower: striped pattern from western Jamaica.

A shift of opinion is later evident in Barbour and Ramsden, (1919, Mem. Mus. Comp. Zool., 47:125): "Gundlach . . . confused the species [*S. nigropunctatus*] with *Sphaerodactylus argus* Gosse which is a species wholly confined to Jamaica."

Barbour finally admitted that Gundlach might have been correct, (1935, Zoologica, 19:103): ". . . *argus*. Possibly introduced casually into Cuba and the Bahamas." He made the same remark two years later (1937, Bull. Mus. Comp. Zool., 82:114).

In Jamaica I have recognized two color pattern races (1940, Grant, Bull. Inst. Jamaica, Sci. Ser., 1:71). The form at the eastern end of the island is spotted or plain. The western form is striped. It is the spotted form which is found in Cuba. I found *S. argus* as numerous as *S. cinereus* at the Harvard Arboretum, near Cienfuegos, Cuba in December, 1941. In two collections I have seen it labeled "*S. nigropunctatus*. Cuba." Neither *cinereus* nor *argus* was seen at Banes or Preston, northern Oriente, in April, 1956.

S. argus Gosse should be included in the herpetofauna of Cuba.—*Chapman Grant, Rt. 1, Box 80, Escondido, California.*

Dromicus in Cuba

By CHAPMAN GRANT

Thirty-seven specimens of *Dromicus andreae orientalis* (Barbour and Ramsden) were taken at Banes, Oriente Province, Cuba, from April 5-26, 1956, while the writer was a guest at the United Fruit Sugar Company plantation. This series came from within a quarter mile of the Company Club House and represents a population from a single ecological environment. Variations are probably individual and not indicative of speciation. There are 16 males, 19 females and two of undetermined sex.

The subspecies from Oriente now known as *Dromicus andreae orientalis* (Barbour and Ramsden) has never been well described. The authors stated (Mem. Mus. Comp. Zool., 47, 1919:196) "Specimens of *Leimadophis* collected in the Island of Pines were much more profusely marked with white than specimens from western Cuba and were named *L. nebulatus* (Barbour, Ann. Carnegeie Mus., 1916, 10: 305). Since then the junior author has sent to the M.C.Z. similar specimens from Oriente. The fact that the Island of Pines specimens seem to be peculiarly marked while those from a distant part of Cuba bear similar markings would suggest that the name *nebulatus* might for the present, at least, be allowed to stand, and possibly we must recognize a similar race peculiar to Oriente for which the name *orientalis* would be appropriate (Type, M.C.Z. 11,726 from Guantanamo)." Barbour subsequently published three lists of Antillean herptiles without mention of *"orientalis"* (Zoologica 11[4],1930; Id.19 [3],1935: Bull. M.C.Z., 82[2],1937). Dr. Pastor Alayo Dalmau (Lista de los reptiles de Cuba, Univ. de Oriente, Museo "Charles T. Ramsden," Santiago de Cuba, 9 May, 1955, mimeo.) lists on p.24, *"Dromicus andreae orientalis* (Barbour & Ramsden)."

Apparently the only description that Barbour and Ramsden gave us of *orientalis* is that it is "similar" to *nebulatus* and that the type, if anyone cared to describe it, is M.C.Z. 11,726 from Guantanamo.

Dr. Dalmau, after recognizing the form, went on to say as this author translates it: "This is the eastern subspecies. It is close to the form from the Isle of Pines (*nebulatus* Barbour) in its appearance, but it has more dorsal light spots and markings, which make it very attractive because in life these markings are light blue."

In order to further differentiate between *nebulatus* and *orientalis* it is necessary to quote from the original description of the former (Barbour, 1916 *loc. cit.:* 305). Barbour made a full species of *L. nebulatus,* Type, M.C.Z., No. 11092: "This form does not differ from *L. andreae* of Cuba in squamation, but it does differ regularly and definitely in color-pattern . . . In the type the lateral boundary between the dark, almost black dorsal and the *ivory-white ventral areas* [ital. ours] is not clearly defined, and there are irregular dark-centered rhombs of white extending up on the sides of the anterior part of the body, sometimes almost meeting at the middorsal line. Along the sides are many irregular scattered white spots. The figures, Pl. 28, show the details. In Cuban specimens (*andreae*) there are no such extensive white markings, but only occasional scattered white dots or vertical or horizontal [we believe

he meant oblique] series of small dots, more often no white at all in the dark dorsal and lateral zones."

If, as Barbour says, the venter of *nebulatus* is (in at least 75% of cases) "ivory-white," this constitutes a marked difference between it and *orientalis,* in which only one specimen of 37 had an ivory-white venter, the remainder having evenly black-edged ventrals.

D. andreae has (Grant, Copeia, 1943, 3:195) ". . . ventrals milk-white edged with black, the black edging becoming progressively wider posteriorly to such an extent that some specimens have the last third of the body nearly solid black . . ." Apparently these three subspecies can be most readily separated by the color of ventrals.

Stejneger had earlier suggested the possibility of another form from

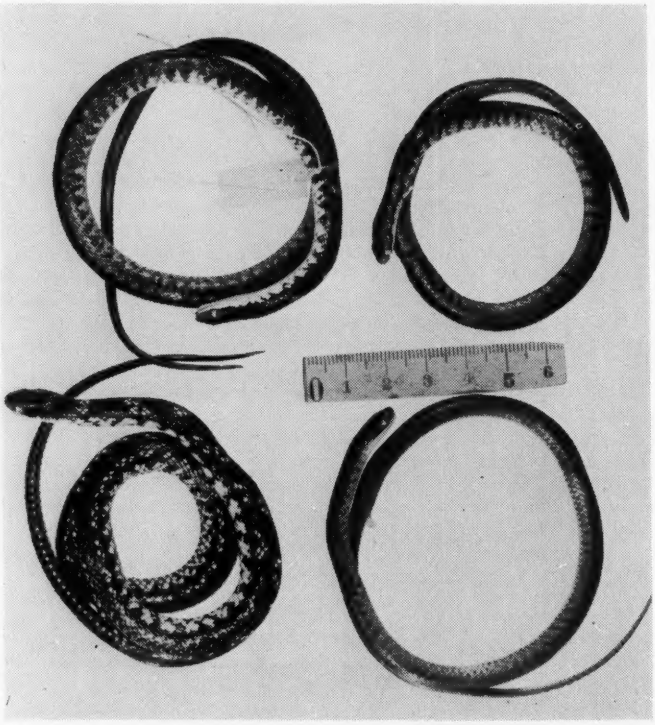


Plate A. Lower right, hatchling male; a light tawny brown snake showing slight evidence of pattern near head. Two upper figures, older snakes, still brown, but showing considerable development of lateral pattern and dorsal dots. Lower left; completely patterned, showing lateral pattern, dorsal rosettes and posterior rows of dots.

eastern Cuba (1917, Proc. U.S.N.M. 53:284): "A male from Santiago de Cuba (No. 26764, USNM) is unique in having the back crossed from ventrals to ventrals by numerous (more than 80) light cross bars formed by the narrow white margins of the scales. The black intervals are slightly wider than the light cross bars." He mentions USNM No. 29780 as having about 50 white cross bands. He goes on to say that the white-banded specimens might be considered a subspecies were it not for USNM No. 29850 taken at Baracoa near the eastern end of the island and which is a typical *andreae* without white blotches or cross-bands. *D. a. orientalis* is an approximation of a reappearance of the color-pattern of *nebulatus,* whereas the cross-banded specimens described by Stejneger are unique in pattern for the whole island as far as known. The fact that

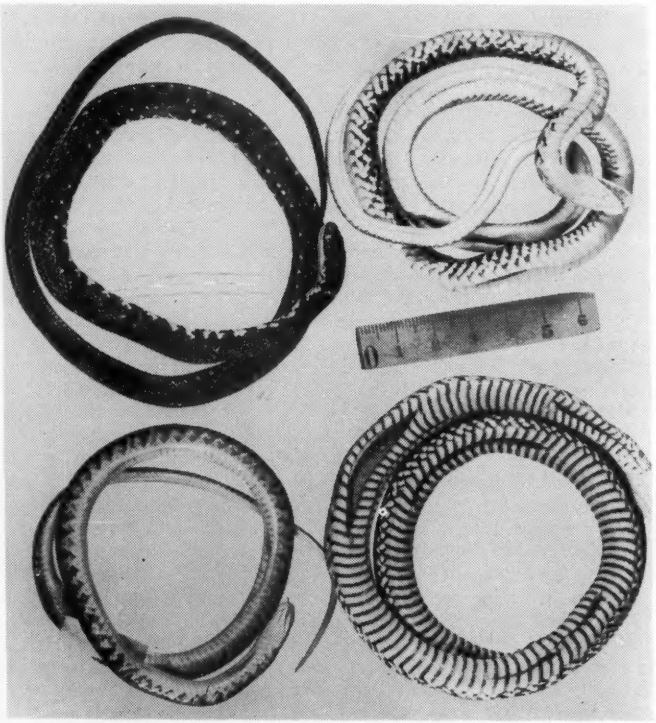


Plate B. Lower right, normal pattern of black-edged ventrals. Upper right, unique example of ivory-white venter. Lower left shows beginning of black edging on ventrals in young. Upper left, completely patterned, showing absence of dorsal rosettes, but accentuated dorsal rows of white dots; an individual variation from the average.

the *andreae* pattern may reappear on the eastern tip of the island does not deny the existence of an isolated population of subspecific value in the Santiago area. However, Dr. Dalmau states in letter Oct. 16, 1956. "I have a large series of *D. orientalis*—about 200 in the Ramsden collection and several in my collection. I found that all the specimens collected in the eastern part of the island agree in having blotches of pale blue on the dorsum, substituted by dots of the same color on the posterior half of dorsum and tail . . . plenty of specimens have been collected in the vicinity of Santiago de Cuba which are identical with others from other parts of Oriente Province."

Scutellation: In my series there is no secondary sexual difference except in the tail. Ordinarily the 5th and 4th upper labials enter the orbit broadly and the 3rd narrowly. In Nos. 2 and 9 the third fails to touch the orbit. Scale rows uniformly 17-17-15. Anal divided uniformly from left to right caudad (see Grant, Herpetologica, 2, 1944: 114-117). There are 5 females, 4 males and 2 of undetermined sex in which there are abnormalities in the preanals or anals, but with no sexual significance. A male, No. 12, has a small median scute between the 36th pair of caudals; an abnormality never before seen by the writer in any species (see Grant, Proc. Indiana Acad. Sci., 46, 1937: 246-252). Both sexes averaged 149.5 ventrals. Fifteen specimens had broken tails. Of the perfect specimens, 6 males averaged 105 caudals and 18 females averaged 98.7. The number of caudals was the only squamal secondary sexual index discovered.

Scale pores: Scale pits or pores are difficult to see, but occur on all specimens examined on the dorsal region anterior to vent. An oblique light causes them to shine and they can then be seen under a hand lens. One female, No. 11, has many scales with two pits. No sexual significance to number or location of pits was noted.

Proportions: The only sexual difference noted was in the percentage of tail into body: In 8 males, 50-59, av. 54%. Ten females, 43-53, av. 47.2%.

Size: Largest female, s-v 470, tail 205 mm.; largest male, s-v 490, tail 246 mm.

Ecology: At Banes this species is called "grass snake"; it feeds principally on small frogs, *Eleutherodactylus varleyi* Dunn. Most of the females contained four to six yolks about 10 mm. long by half that width. No evidence was found of any burrowing habits as mentioned by Barbour (1916, *loc. cit.:* 306).

Change of color-pattern with growth: Usually young reptiles are vividly marked, the pattern becoming obscured with growth. Dr. Cochran (Bull. USNM, 177, 1941:136) writing on this genus said of Haitian specimens: ". . . in the younger (snakes) the tones are much more definite." It is surprising to find the opposite in the Cuban *Dromicus.*

Stejneger (1917: 285, *loc. cit.*) said: "A young specimen (No. 27398) collected by Palmer and Riley at El Guamá, March 26, 1900, is worthy of mention as being a partial albino of the typical form, in which the black is absent, the back being medium tawny gray." Dr. Cochran, letter Oct. 17, 1956, kindly checked this specimen and found it was only 260 mm. s-v. which throws it into the length group which is tawny brown in our series.

One specimen, No. 21, a female which falls well within the size bracket of fully colored specimens, displays the mature pattern except that it is brownish and blurred in appearance. This may be a different variation or a delayed change from juvenile to adult color.

Much more collecting will have to be done before better than vague generalities can be made of the areas of intergradation of the variously patterned populations. One can travel from Havana to Banes without seeing any differences in terrain sufficient to seem to require any modification of appearance of this snake.

From what little I have seen it appears that writers should describe the ventral pattern as carefully as the dorsal.

ROUTE 1, BOX 80, ESCONDIDO, CALIF.

THE GECKO *HEMIDACTYLUS FRENATUS* IN ACAPULCO, MEXICO.—During a stay in Acapulco from Dec. 29, 1955, to Jan. 2, 1956, opportunity was had to observe and take 15 specimens of *Hemidactylus frenatus* Schlegel. They take position at dusk near artificial lights on walls or ceilings where fights for territorial rights ensue when specimens find themselves within 10 feet of one another. Calls from forested or rocky terrain indicate that they are not confined to inhabited situations. The Mexican name of "cuija", pronounced "quee-ha", does not seem to describe the call, which resembles clucking with the tongue, repeated rapidly several times. One pair was found mating in daylight.

No pattern was apparent in daylight and no color change noted on the brown body. By comparing several, a pair of faint dorsal lines was discerned, formed by scattered brown specks; a similar pair extended from eye to groin on each side, making 6 indistinct lines in all. A row of small, weak tubercles occupies each line and occasionally there are a few between dorsal and lateral lines, representing a total of 8 rows. Some specimens are almost without tubercles.

These specimens are Nos. 19187-19201 incl., San Diego Soc. Nat. Hist. Museum, San Diego, Calif.

The table represents the salient differences between the four New World forms. Parenthetical figures represent rarity.

	Pattern	Femoral pores on each side; males only	Rows of tubercles across back	Tubercles ear to ear
brooki	4 irregular rings shoulders to sacrum, or marbled	13	18	14
mabouia	6 black "V"s shoulders to sacrum	16 or 17	12	18
turcicus	round brown markings, no pattern	3 or 4	14 (16)	14
frenatus	faint longitudinal lines of dark dots	14 to 16	6 (0-8)	0

—*Chapman Grant, Rt. 1, Box 80, Escondido, Calif.*

THE BLACK TAILED *TROPIDOPHIS* (REPTILIA: *SERPENTES*).—Barbour and Ramsden (1919, Mem. Mus. Comp. Zool., 47:189) describe the color of living *Tropidophis melanurus* (Schlegel), adding: "In spite of the name neither Gundlach nor we have seen an individual with a black tail." I took a series of 8 at Banes, northern Oriente, Cuba, in April, 1956, which illustrates the change of color with growth from green to black of the finger-like distal third of the tail. The tail tip is greenish yellow in young up to about 300 mm. snout-vent. In specimens from 400 to 500 mm. the tip is black above and green beneath. From about 670 mm. only a few flecks of green remain underneath the black finger-like tip.

Dr. Pastor Alayo Dalmau, of the University of Oriente, Cuba, kindly answered my query as to the color of the tails of larger specimens. Under date, Oct. 16, 1956, he wrote: "I have just examined 150 specimens in the Ramsden collection, some of very large size, and found that the black tail is not a constant character. In females nearly all the specimens have the tail concolor with the rest of the body; in males several show a distinctly black tail." No. 5 in my series is a female and has a black tail tip. As Dr. Dalmau states, the black tail is not a constant sexual index and may occur in females. He did not specify that the specimens he examined had perfect tail tips. In my two largest specimens the tip is missing and they are both females.

Barbour and Ramsden (*op. cit.:* 188) state that the color in life varies; ". . . corn-yellow, reddish and ashy gray . . ." I believe that the corn-yellow individuals are true partial albinos which retain the yellow pigment and not the black. Furthermore the yellow pigment has its definite distribution and does not occur where the normally colored snake has black blotches. The absence of black spots in the corn-yellow individuals is replaced, not by the yellow background, but by light spots. The black pigment of normal specimens is so dense that it is difficult to see the outlines of the head scales whereas the yellow specimen shows all scales distinctly and each appears to bear pores.

This species is said to have keeled scales. My specimens show a rather blunt keel at the center of the scales. At the termination of a row there is frequently a single large scale which bears two of these blunt keels.

The largest specimen contained 36 eggs about 7 mm. in diameter.

DATA OF THE SERIES

No.	SV,mm.	tail	scale rows	sex	ventrals	caudals
1	160	25	25-27-19	m	195	38
2	255	32	27-29-19	m	197	36
3	397	48	27-29-19	m	200	35
4	405	50	25-27-19	m	194	35
5	530	55	25-27-19	f	197	35
6	670	70	25-27-19	m	200	38
7	680	?	25-27-19	f	199	?
8	950	?	25-27-19	f	194	?

—Chapman Grant, Route 1, Box 80, Escondido, Calif.

An Observation of Mating in the Broad-headed Skink, *Eumeces laticeps*

By OLIVE B. GOIN

The following observations were made in the back yard of our home near Gainesville, Alachua County, Florida. The yard is a wooded, typically mesic hammock area in which water oaks are the dominant trees. At their bases most of these oaks have hollows inhabited by Broad-headed Skinks, *Eumeces laticeps*. During most of the period of activity, from the end of March through September, only one adult skink will be found living on any one tree. The lizards are most often seen close to the holes not more than a foot or so above the ground. For the sake of convenience in making notes, we have named a number of the trees. The East Oak and West Oak are about forty feet apart. Making a triangle with them, about twenty feet northeast of the West Oak and thirty-seven feet northwest of the East Oak is the Thermometer Oak to which a maximum-minimum thermometer is attached. About ten feet northwest of the Thermometer Oak is a fourth oak with twin boles. One side of this tree has died and broken off leaving a dead stump about five feet high.

At 11:30 on the morning of April 29, 1957, a male *Eumeces laticeps* was seen on the East Oak and a female on the West Oak. Both had fully mature coloration but they were not so large as these skinks frequently become. At 2:15 that afternoon both were on the West Oak. They were disturbed by the approach of a cat and both went into the hollow of the tree. In a short time the female came out, crossed the ground to the Thermometer Oak and entered the hollow in it. Some minutes later the male emerged. He appeared to hunt for the female by smell, frequently flicking his tongue out and finally followed her over to the Thermometer Oak. In the meantime she had crossed over to the tree with the double bole and entered a small hole in the dead stump. He again followed and climbed the living part of the tree. She emerged and in a few minutes jumped over to the part of the tree where the male was. Both animals would rest close together for a few minutes, then she would move off for a short distance, he would follow and they would again rest. Both animals "bobbed" occasionally, the male somewhat more than the female. They climbed up the tree, then down and started back toward the Thermometer Oak. We had them under almost constant observation for nearly two hours but did not observe copulation.

The next morning at 10:45 both lizards were on the West Oak a few inches apart. Again the female would move a short distance, the male would follow, then both would remain quiet for a long period. Movement was always initiated by the female. She did not travel so far each time as she had the previous afternoon, usually not more than about six inches. As the male followed he sometimes walked beside her tail but most frequently he straddled it and when they stopped his head rested on her pelvic region. In this fashion they moved slowly around close to the base of the tree. Finally, on the surface of a large root about two inches above the level of the ground, the male moved up on the left side of the female and grasped her neck in his jaws. His right front leg was thrown

across her back slightly behind her front legs and his right hind leg in her pelvic region. The male's body was curved in a semicircle and his tail swung under the base of her tail at right angles to it. The male then began a series of rapid thrusting movements with the base of his tail. At first the thrusts were at the rate of about two a second but toward the end they became somewhat slower and more irregular. There were about 220 thrusts. Suddenly she shook herself and threw him off. She moved a few inches, scraped her cloacal region and hind legs on the bark of the tree and rested. He moved over beside her. Copulation took place at about 11:15 and lasted not more than three or four minutes. The air temperature was 82°.

During the next forty-five minutes the pair occasionally moved a few inches around the base of the tree with long periods of rest between. Again it was always the female who initiated movement. Once she rested her head across the back of the male but usually he rested his on her pelvic region. Several times he opened his mouth widely but apparently made no real attempt to seize her again. Finally she began to move a little more quickly, came to the ground and slowly made her way over to a thicket about twenty-five feet away. He still followed closely. When the pair was finally lost from view nearly an hour after copulation had taken place the male was still so close behind that he straddled her tail as they walked. Although the skinks had been disturbed the previous afternoon by the approach of a cat, they were unperturbed by the near presence of a human observer. During much of the period of observation I stood within three feet of them.

Fitch (1954, Univ. Kansas. Publ., Mus. Nat. Hist., 8 (1):48-49) has reported mating behavior in the Five-lined Skink, *Eumeces fasciatus*. The main difference between *fasciatus* and *laticeps* seem to lie in the length of the pre- and post-copulatory phases. Apparently in *fasciatus* the male attempts to grasp the female almost immediately after he has found her. After copulation he follows the female, but according to Fitch the association usually does not last more than a few minutes.

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AUTOPHAGY IN *EUMECES*.—Mrs. Irene Bolderson of Escondido, Calif. captured a *Eumeces skiltonianus* about 3 inches s-v. In the capture about 2 inches of the tail was broken off. The live lizard and the broken tail were placed in a pint carton. The following day it was noted that the tail had disappeared and two days later the lizard died and was given to me for dissection. The tail was in the lizard's alimentary tract, large end down and the very thin tail tip was broken off and was in the lizard's gullet.

Dr. H. M. Smith states that similar records exist by Carr (Herp. Fla., 1940) and McCauley, (Herp. Md., 1945:45).—*Chapman Grant, Escondido, Calif.*